Water Works and Sewerage

Vol. LXXVII APRIL, 1930 No. 4

Construction Methods on Cheyenne Reservoir

By P. R. REVIS
City Engineer, Cheyenne, Wyo.

Economical methods marked the construction of a storage reservoir at Cheyenne, Wyo., during the past year, as a part of a water-supply extension program inaugurated by the city in 1928.

Pouring Floor Slab, Cheyenne, Wyo., Reservoir. Trenches May Be Seen in Foreground

The filter plant has a capacity of 12,000,000 g. p. d. The water, after leaving the plant, is placed in storage reservoirs from which it enters one 30-in. and one 16-in. pipe line. The two lines carry the water to the distribution system in the city and also supply Fort F. E. Warren. These are also gravity lines, and Cheyenne has a constant pressure of 125 lb. per sq. in. in its distribution system.

When the original water system was constructed, one filtered-water storage reservoir, of 7,000,000 gal. capacity, was constructed at the site of the present filter plant. This reservoir was adequate until about two years ago, at which time plans were drawn for the construction of additional storage facilities.

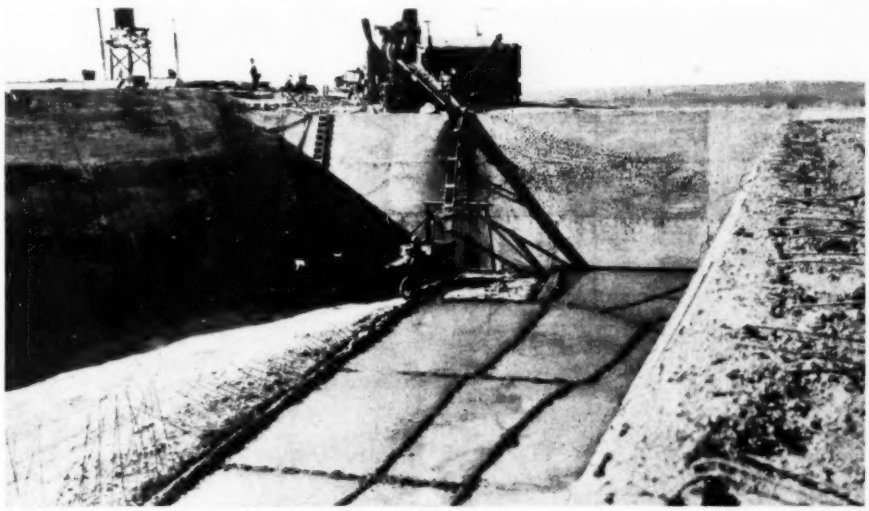
In order to maintain the same water pressure in the city and because of the peculiar contour of the hill upon which the filter plant and reservoirs are situated, several difficulties were encountered in the design. Too, it was proposed to have a capacity of 7,000,000 gal. in the new reservoir. The new reservoir may be described as having a peanut shape.

Earth excavated from the basin area was used as additional embankment along the outer wall. This earth, after compacting, was trimmed to a ½:1 slope to conform to the outside of the concrete wall. No outside forms were used. The walls were built in three lifts of 8 ft. each. Wooden inside forms were used and each section was 10 ft. in length, thereby simplifying the raising of the form sections for each lift. The concrete walls are 7 in. thick, with ½-in. reinforcing bars spaced 12 in. on centers both ways.

The first lift of the wall, being next to the floor, was designed with a key for the floor and reinforcing bars extended outward 3 ft. and embedded in the floor. Before concrete was poured on the floor, the base was divided into sections so that placing operations would not need to be discontinued at any time.

The floor was designed as a beam-and-slab type. The subgrade was first finished off, and trenches were then cut into the subgrade. The trenches when filled with concrete acted as beams. These beams were placed 14 ft. on centers. The slab and beams were reinforced with ½-in. reinforcing bars laid 12 in. on centers both ways. The walls were given a 1-in. coating of gunite.

The concrete for the walls and floor was mixed in a portable mixer which was operated along the walls as each section was poured. For the floor the concrete was chuted and buggies were used to move it to the section being poured. The concrete mix was 1:2:4. A careful check of the materials and a minimum use of water resulted in high-strength concrete as well as a saving in the amounts of material used.



Curing Reservoir Floor by Flooding

The actual cost, $52,435, included one 20-in. inlet, one 30-in. outlet, fencing and leveling of the embankment.

Weather Cycles Due to Planet Lowell

By HALBERT P. GILLETTE

IN the March issue of "Water Works and Sewerage," I called the ninth major planet Apollo. I had previously designated it as Planet "A." Announcement of the discovery of a planet having an orbital period of about 300 years was made by the Lowell Observatory on March 13, 1930, two days following my selection of the name Apollo for a planet that causes a magnetic cycle of about 317 years. In Prof. Lowell's original memoir, published in 1915, it was estimated that the ninth major planet has an orbital period of about 290 years. As the newly discovered planet is doubtless the one that Prof. Lowell originally predicted, and as its orbital period will probably be found to be sufficiently close to the 317-year magnetic cycle that is manifested by unusual auroras, sunspots and weather disturbances, it seems best to drop the name Apollo, and to substitute the name Lowell. Certainly if any astronomer was ever entitled to have his name given to a planet, it is Prof. Percival Lowell of Harvard. International jealousies deprived Herschel of the honor of having his name applied to what is now known as the planet Uranus. The almost simultaneous prediction of the longitude and latitude of Neptune, by Adams of England and by Leverrier of France, again aroused international jealousies that prevented either of those two astronomers from being honored by having the planet named after him. But no such condition, I trust, stands in the way of naming the ninth major planet after its real discoverer, the man who located its approximate position by its calculated effects on the path and velocity of Uranus. Although Prof. Lowell has been dead 14 years, the astronomers of the observatory that he founded were the ones to photograph and see this new planet for the first time, guided by his original calculations. The right to have the name Lowell applied to this planet has been doubly earned, first by Lowell the astronomer, and second by the Lowell Observatory.

Although I was right in my original inference that planet Lowell caused the great sunspot peak of 1778 (the greatest since sunspots have been accurately counted), I underestimated the length of the sunspot cycle due to that planet, calling it 290 years ("Engineering and Contracting," October, 1928). A few months ago I found that each of the eight major planets not only causes a sunspot cycle whose length is somewhat less than its orbital period, but that it causes subcycles whose lengths are one-twelfth of the length of the mian cycle. This discovery has enabled me to determine the length of each magnetic cycle with greater accuracy, for obviously a twelve-fold increase in the number of maxima adds to the accuracy of the estimated length between maxima. Planet Lowell itself furnishes as good an example as any of this use of subcycle maxima to establish the length of the main cycle.

I assume that each major planet has two "shells" of electrons, one in its upper atmosphere, corresponding to the "Heaviside layer" above the earth, and one in its liquid interior. Each of these two electron shells contains at least 12 permanent electron whirls. Photographs of Jupiter clearly show circular areas whose centers are about 30 deg. apart in longitude. The existence of 12 molten whirls in the earth is shown by topographical arcs (see "Engineering and Contracting." October, 1928, and October, 1929). Hence there is occular evidence of the existence of 12 major whirls on two of the planets, in their lower fields.

By assuming that the upper shell of electrons has magnetic poles that rotate slowly clockwise (when viewed from the north) about the axial poles, it is possible to explain how a planet can cause magnetic maxima on the sun at intervals less than the orbital period of the planet. I have derived a formula that shows the functional relationship between a planet's sunspot cycle and its orbital period ("Engineering and Contracting," October, 1928), and this formula fits the facts as to the eight planets so closely as to establish its substantial correctness. By this formula it can be shown that if the main sunspot cycle of Lowell has a mean length of 316.7 years, its orbital period is about 323 years.

In the case of the eight major planets the following formula shows an average error of only 2.5 per cent, and an extreme error of 10.7 per cent, hence it is presumable that its application to planet Lowell will give an error not exceeding 10.7 per cent, or about 35 years. If such an error occurs, Lowell's orbital period may be 358 years, but it can not be less than its sunspot period of 316.7 years, if my theory is correct. Hence Prof. Lowell's original estimate of 290 years is too low, and even the recently announced estimate of 300 years is too low. An excellent test of the correctness of my theory will be had if it shall ultimately be found that planet Lowell's orbital period is between 317 and 358 years. My formula for the relation of mean magnetic or sunspot cycles (t) to mean orbital velocity (T), when orbital velocity in miles per second is v, is

$$(1)\quad t = T(1 - .007\ v)$$

For the solar system this becomes:

$$(2)\quad t = T - 0.13\sqrt{T}$$

This formula gives the following theoretical lengths of magnetic or sunspot cycles, which are compared with the actual lengths.

Causative Planet	Cycle Theoretical	Cycle Actual	Per Cent Difference
Mercury	69.7 days	70.3 days	+ 0.9
Venus	190.7 days	196.4 days	+ 3.0
Earth	10.44 mos.	10.93 mos.	+ 4.7
Mars	20.21 mos.	18.06 mos.	—10.7
Jupiter	11.19 yrs.	11.20 yrs.	+ 0.1
Saturn	28.24 yrs.	28.05 yrs.	— 0.7
Uranus	81.35 yrs.	81.11 yrs.	— 0.3
Neptune	161.97 yrs.	161.55 yrs.	— 0.3

It should be noted that in every case the magnetic cycle is less than the orbital period of the causative planet.

I find that the magnetic cycle of 316.7 years is so uniform that planet Lowell must have an orbital velocity that is quite uniform, which means that its orbital eccentricity is probably slight.

I think that Prof. Lowell's errors (if subsequent observation proves them to exist) as to the orbital period and the size of the ninth major planet, will be found to be due to the existence of planet "B," or Janus, whose magnetic and sunspot cycle is 633 years. If the longitude of this tenth planet has not differed greatly in recent years from that of planet Lowell, it would account for Prof. Lowell's difficulty in estimating more correctly the position, size and velocity of planet Lowell. In this event the visual discovery of the tenth major planet is likely to occur very soon.

Planet Lowell has a magnetic subcycle of one-twelfth its main cycle of 316.7 years, or 26.4 years, which is very pronounced in its weather effects. Its last maximum was in 1910 and its next will be in 1936.

In the next issue of "Water Works and Sewerage," proof will be given in detail of Lowell's 316.7-year magnetic cycle and its 26.4-year subcycle, based on sunspots, auroras, rainfall, tree growth, earthquakes, etc.

Lowering Ground-Water Level by Pumping

An interesting experiment is being tried on the Yuma reclamation project in Arizona to determine the feasibility of lowering the water-table by drilling wells and pumping the seepage water back into the Colorado River. The sum of $15,000 has been made available and a test well having a 24-in. casing will be driven.

The experiment will be watched with interest and should it prove successful other wells will be drilled in the valley. The proponents of the project hope that not only will the underground water level be lowered but also the wells may have considerable effect in leaching salts from the soil.

SEWAGE DISPOSAL WORKS

A Section Dealing with Their Design, Construction and Operation

Conducted by JOHN R. DOWNES, Associate Editor

Supervising Engineer, the Plainfield and Dunellen, N. J., Sewage Disposal Works

Annual Meeting New Jersey Sewage Works Association

The general enthusiasm which attends all meetings of sewage works men was evident at the 15th annual meeting of this pioneer sewage works association in Trenton, N. J., March 21 and 22.

Over 250 men, hailing from Maine, Massachusetts, Connecticut, New York, Delaware, Maryland, Pennsylvania, Ohio, Illinois and Missouri made up the assemblage.

Glass Covers.—H. Burdett Cleveland, Consulting Engineer of New York City, described the features of the Red Bank, N. J., treatment plant recently completed. The plant has separate chlorination with provisions for drying the sludge under glass. Glass cover design with rather elaborate provision for ventilation was chosen as a precaution against odors at a site in close proximity to neighbors and highway, in preference to trying to seclude the plant at some distant site, the adoption of which would necessitate pumping with its attendant expense and uncertainty.

Edward F. Shissler, Superintendent of Works at Haddon-Heights, N. J., described a plant consisting of a two-story settling tank, a separate digestion tank, trickling filters, resedimentation tank and chlorinators. The feature of the plant is a glass cover enclosing both the drying beds and the sprinkling filters, which arrangement has made possible some very interesting investigations. Only a slight earthy odor changing to a soapy odor on the proverbial wash-day has been detected.

Control of Filter Fly.—Mr. Shissler showed that it is possible to control that sprinkling filter pest, the "filter fly," by closing the ventilators of the glass house and thus running the temperature up to from 129 to 147° F., these being the temperature attained on two separate treatment dates. Flies seemed to prefer the moist warm atmosphere normally within the covered area and seldom appeared outside. When the temperature was run up by closing the ventilators the flies were very largely killed off in 24 hours and completely so in 4 days. The latter period started the bed unloading.

It is curious to note that while Mr. Shissler felt some concern about this abnormal unloading of the filters, the next speaker, Mr. Chas. Hommon, Superintendent of Purification at Canton, O., emphasized the forced unloading of such filters as a very desirable feature in keeping the beds clean. Clean, to Mr. Hommon, means a degree of freedom from solid material which would have been considered suicidal a few years ago because it was thought that this accumulation was necessary to the action of the bed. Mr. Hommon forces the unloading and at the same time destroys the flies by the flooding method.

Mr. F. M. Veatch, Consulting Engineer of Kansas City, in describing operating experiences in the West, emphasized the necessity of training the city officials to appreciate the training of the operator and its purpose and profit to the city. He spoke of sewer rental laws as a step in the right direction.

Cost Data.—In commenting on operating and cost data on eight plants in the West he said that the tables of cost presented indicated clearly that additional money spent on raising operator salaries would be money well spent.

Costs presented varied from $68.50 per M. G. to a net profit of $3.62. The experiences tabulated in detail vary from those with an Imhoff plant at an elevation of 7,160 ft. and an average temperature of 40.8° F. to the irrigation farm at Tucson, Ariz., with torrid temperatures around 118° F.

At the Pomona, Calif., activated sludge plant he reports some difficulty with digestion of the activated sludge in the Imhoff tanks. This is lessened by returning the sludge to the tank influent rather than to the digestion compartment proper.

Mosquito Control.—The Jersey mosquito has put his sting into the sewage problem to further aggravate the misery of the operator. However, Mr. Lester Smith, Superintendent of the Middlesex County Mosquito Extermination Work, in a paper on breeding in catchbasins and cesspools, made it appear that while breeding about municipal plants is undesirable the breeding in improperly cared for cesspools is equally troublesome and much more widespread.

He indicated that a change in the design of catchbasins to eliminate the water well would stop the trouble from breeding in these basins. The cost of controlling breeding in 60,000 of these faultily designed basins in Northern New Jersey had been reduced to the sum of $20,700 only by the use of power oil pumps mounted on trucks so equipped that it is only necessary for the driver of the truck to hesitate while an accomplice pull the trigger on the oil gun.

Messrs. LeRoy Forman and Joseph M. Ginsberg, Ph. D. told of preliminary studies of the control of mosquito breeding in disposal plants. Investigations were made on five typical plants in the state to determine the toxic effect of various larvaecides on the mosquito and on the organisms responsible for purification processes.

Standard light oil's use as larvaecides had no bad effect on the organisms in filter beds. The addition of cresylic acid often used to keep such oils on the water surface was found to be detrimental when 10 per cent was added to the oils. Slightly detrimental in 5 per cent solution but harmless at 1.5 per cent. 1.5 per cent is just sufficient to accomplish the desired spreading of the oil.

In a round table discussion on mosquito control, Dr. T. J. Headlee, State Entomologist of New Jersey, told of particular instances of serious difficulties with mosquito breeding at municipal plants and emphasized the necessity of eliminating ponding and weed growth.

He said that a peculiar property of the food supply made available to mosquito larvae by improperly purified sewage is that it permits salt water mosquitoes to develop in fresh water and fresh water varieties to develop in salt water, greatly complicating the problems of the mosquito exterminators.

Sludge As Fertilizer.—Mr. Chester G. Wigley, Consulting Engineer, Atlantic City, described a method of using moulds to prepare green sludge for use as a fertilizer. This fertilizer is particularly adapted to conditions in At-

lantic City, where it sells for $20 per ton. Heat, darkness and limitation of air currents are essential to the growth of these moulds. An attempt is being made to supply heat minus light from the sun by using glass to bring in the light and transform it into heat and wooden baffles to keep the light from reaching the growing moulds.

Dr. Heukelekian, Biologist of the New Jersey Sewage Experiment Station, followed Mr. Wigley and expressed surprise at the success of the former since he himself had attempted something on the same order but found the green sludge too wet to properly support the growth of fungus and the expense of drying the sludge to a condition in which the fungus would flourish so great that ordinary digestive treatment had seemed preferable.

High Temperature Digestion.—Dr. Heukelekian then proceeded to describe his experiments with high temperature digestion. Ordinary digestion is facilitated by temperatures up to 82° F., after which it falls off to be superseded by thermophilic digestion at temperature from 115 to 150. The process gives promise of cutting the required digestive capacity to ½ cu. ft. and possibly ¼ cu. ft. per person.

Fortunately for the maintenance of these high temperatures digestion is not only quicker but more complete, the gasification of a greater proportion of the organic matter yielding a very much larger total quantity of gas.

Mr. Courtland H. Shute, Superintendent of Treatment at Glassboro, N. J., described the Glassboro plant and its operation. He gave special stress to plant beautification and selling the plant to the public in general and to the City Fathers in particular. He also mentioned the very important psychological effect of the condition of the plant on the men who work about it. Cost of operation of this plant for 4,000 persons is only 0.578 in spite of seasonal difficulties with cannery wastes.

Drying Sludge Under Glass Covers.—Mr. Floyd G. Brown and Mr. Frank W. Jones, of Marion, O., and Cleveland, O., respectively gave most interesting data on drying sludge under glass.

The number of glass covers in 1926 was less than 10, while at the end of 1929 there were more than 80. Most of these were built in 1928 and 1929.

They feel that drainage is the important thing during the first two days and that thereafter further drying is due to evaporation.

Affecting drainage are depth and condition of underdrains. Affecting evaporation are height of walls, type and location of walks, type and use of ventilators, etc.

The following data was given on drying at Marion, O.:

Suspended solids in raw sewage, mean, p.p.m.	227.
Volatile matter in green sludge, per cent..	75.1
Volatile matter in ripe sludge, per cent.....	53.0
Loss of solids by digestion, per cent.....	40.0
Average drying period (beds worked at cap.), days	16
Max. drying period required, days.....	43
Min. drying period required, days.....	6

Only 122 of the 314 days during which sludge was on the beds were clear or partly clear and 54.03 in. of rain fell so that without glass drying would have been very difficult.

With sludge 7 to 7.5 per cent solids and applied at depths of 8 to 10 in., 20 dryings per year are possible corresponding to 0.58 cu. yd. per square foot drying area.

The quantity of digested 7 to 7.5 per cent sludge equalled 6.1 cu. yd. or 1,200 gal. per million gallons of sewage.

Costs for glass covered drying beds complete are given as from $2.50 to $3.

Disposal of sludge is still the vital need.

Major Blew told of experiments at the Philadelphia plant with activated sludge treatment. He predicted the development of a semi-complete process with aeration from 40 min. to an hour.

A technical discussion of detention periods in sedimentation tanks by Mr. Elmer App and Mr. James R. Baty of the Bureau of Engineering, State Department of Health of New Jersey, was very interesting and projected a round table discussion among a party of engineers that lasted far into the night. A plea was made for support for further investigation of this very interesting subject.

Impressions of Meeting.—Summing up the impressions from the meeting:

Sludge disposal after drying is still the vital issue.

From three widely separated sources, three various means of preparing fertilizer from sludge and marketing it were brought out.

Uniform production of sludge is desirable from the marketing end and essential to the operating end. The two are therefore compatible.

Sewage disposal seems to be rapidly emerging from the state in which the plant was a thing to be buried and shunned to a state in which it is to be beautified and sold to the public.

Publicity is now the watchword and it is necessary to educate city officials up to the point where they will make use of the opportunities which the cooperative efforts of state health departments, operators and consulting engineers are making available.

Batch Boxes Given Sloping Floors

In reconstructing the Harahan viaduct, across the Mississippi River from Memphis, Tenn., and leading to the Harahan bridge across the river, the contractor used special batch boxes in industrial-railway trains. Each box had four compartments. The compartments were 1x4 ft. in horizontal section and 4 ft. high, and the bottoms were given a 40-deg. slope so that opening the side doors would empty the boxes quickly.

Carbonate Hardness Reduction at Columbus, O.

The following notes on the results of operating the new process for reduction of carbonate hardness by lime softening to the theoretical limit are taken from the annual report for 1929 of Charles P. Hoover, Chemist in Charge of the Water Softening and Purification Works of Columbus, O.:

During the years previous to the installation of the recarbonation plant, the average alkalinity of the filtered water was 51 parts per million. This past year (1929) the alkalinity of the filtered water averaged 30 parts per million. This further reduction in alkalinity has been made possible because of an improved process of operation that has been adopted. The adoption of this process has been made possible because of the recarbonation plant.

The process consists in:

(1) Applying from 25 to 50 parts per million or more of lime in excess of that theoretically required to combine with the free and half-bound carbon-dioxide and to precipiate the magnesium;

(2) Settling through first four basins;

(3) Carbonation in about the middle of the fifth and sixth basins to the point where two times the phenolphthalein alkalinity subtracted from the total alkalinity equals approximately 5;

(4) Settling in latter half of fifth and sixth basins and filtering through sand filters.

This process throws a considerable burden on the sand causing some incrustation and cementing together of the sand grains.

The following modification of the process has been developed and tried out in the laboratory with very satisfactory results.

(1) Use from 25 to 50 parts per million or more of lime in excess of that theoretically required to combine with the free and half-bound carbon-dioxide and to precipitate the magnesium;

(2) Settle out settable precipitates (this is preferable but not essential);

(3) Neutralize excess lime with carbon-dioxide gas;

(4) Mix with calcium carbonate or water softening sludge, approximately 1,500 more or less parts per million;

(5) Settle; and

(6) Filter.

The reduction of alkalinity or carbonate hardness to an average of 25 which, it is believed, can be easily obtained, instead of 51 as in past years results in a great saving. Had the process been known 21 years ago when the Columbus plant was put in operation, it would have saved in the chemical cost of softening Columbus' water supply over $400,000.

Sanitary Engineering in the Public Health Service

Duties of Sanitary Engineers in Administrative Positions in the U. S. Public Health Service, Particularly with Reference to Work in Eastern United States and the National Parks

By ARTHUR P. MILLER

Associate Sanitary Engineer, U. S. Public Health Service

IN this great country, the states have well defined duties and functions to perform and it is well understood that while the Federal Government may cooperate with and aid state and municipal boards of health in the execution of their rules and regulations, it must not transgress their rights. Obviously then, the relations of the Public Health Service officials with municipal and local health agencies, water and sewage treatment plant operators and the like are cooperative and advisory. Such contact as we have with them is always through and with the consent of the proper state officials and then is usually of an advisory character. The sanitary engineers in my service do not have opportunities comparable to those of state personnel to investigate, inspect and know individual water treatment plants in their own states. On the other hand, any one of our district engineers does have the chance in traveling over his large territory to know generally about water supply and purification matters in each state covered by him, even though he may not have intimate knowledge of all the details. With this general knowledge, we are in a position, in conferring with state engineers, to pass on to them whatever may be of value in their particular fields of activity. This opportunity to act in a liaison capacity has been very helpful not only to us but we believe to state personnel.

Besides the health affairs of the states, we must consider those of the larger unit—the nation. It can be recognized readily that where forty-nine political units are grouped together as closely as our states and the District of Columbia, some agency of broader scope than the state must be charged with the responsibility of caring for matters affecting health which either develop on the outside of our national boundaries or which involve more than one state. It is under such circumstances that the Public Health Service has a duty to perform.

Supervision of Water Supplies of Common Carriers.—Congress has recognized this and has charged the Public Health Service with the execution of certain specific duties only one of which I will touch upon. Although not exclusively, the Congressional Act of 1893 authorizes the Secretary of the Treasury to cooperate with and aid state and municipal boards of health in the execution and enforcement of rules and regulations made by the Secretary to prevent the introduction of contagious or infectious diseases into the United States and into one state from another. Under this Act the Secretary of the Treasury in 1912 issued the Interstate Quarantine Regulations. There is included in these regulations a section which states that "Water provided by any person, firm, company, or corporation for drinking or culinary purposes on any car, vessel, or other conveyance while engaged in interstate traffic shall be from a source which is approved by the Surgeon General of the United States Public Health Service as producing water of satisfactory sanitary quality and safety." You will now recognize one reason for sanitary engineers in the Public Health Service, namely, the supervision of water supplies used on common carriers.

To assure the quality of the drinking and culinary water on common carriers in 1912 was a large task, particularly with the personnel available at that time. The first step, which was taken in 1914, was to set up a bacteriological standard for the quality of that water. Using that as a working basis, state or municipal health authorities were empowered to certify to the Surgeon General the suitability of any source of water desired for use by any particular railroad. As we look back now on this system and bear in mind the stage to which water purification has advanced, we hesitate to consider just how successful this plan could have been in keeping water consumed by travelers satisfactory for that use. Another point which complicated the work then was that there were engineering divisions in but twelve state health departments. Actual records indicate that only fourteen states really functioned under this plan for certifying common carriers' water supplies.

Cooperation with State Health Departments.—In spite of deficiencies, however, the ground work was laid. In 1919 the present scheme was adopted, which involves close cooperation with all state health departments because of the fact that most of the field work necessary to ascertain the suitability of any water supply rests upon them. Using the reports made by the states, the Surgeon General of the Public Health Service issues annually proper certificates denoting approval or disapproval to common carriers on the supplies which they wish to use. This plan relieved the Service of the necessity of setting up a large field organization of its own, the activities of which would to a considerable extent have duplicated the work of the states and, on the other hand, it has been of much assistance in bringing about the establishment of engineering divisions in state health departments.

Another potent factor in this scheme has been the effect of the relatively high Treasury Department standards on the general character of the drinking water of the United States. This standard established by an advisory committee in 1922 is threefold and includes a sanitary survey and bacteriological and chemical limitations. Although it is not put out for general use, its application has become quite widespread. That fact, coupled with the necessity for many municipalities meeting this standard so that their water may be taken by common carriers has had an influence in raising the general plane of water quality throughout the country.

The relation of this work to the increase of engineering divisions has been mentioned. Some years ago the policy of the Service was to loan engineers to state health departments when they did not have their own engineering personnel. The duty of the loaned engineer was primarily to bring about the necessary investigations permitting the certification of common carrier water supplies and secondarily to assist the state in all other public health engineering work. This policy eventually brought many states to realize the helplessness of engineering personnel in their state health groups and resulted in quite a few states employing their own men.

From 1914 to 1922 engineering divisions rose in number from twelve to thirty-six and now there are forty-four. Today every state engages in this certification work although the Public Health Service personnel still helps in those states without engineers and even in some of the others. As recently as 1920 the percentage of completion of certification was only forty-two, but now it is something over eighty. Even though this percentage is still low, it is felt that a larger percentage of the traveling public receives satisfactory drinking water because most travel is to and from metropolitan areas and without exception their water supplies are in the approved group.

Decentralization of Certification Work.—At this time I wish to mention a plan now under consideration which

will materially decentralize the certification work and place more of it in the five engineering field offices of the Service. If it becomes effective it will bring the Public Health Service engineering staffs and those of the states into much closer contact.

We have considered now the sources of water but one must also think of it after it leaves the distribution system. This involves two very distinct problems—(1) the supplying of water to railroad trains, and (2) the furnishing of it to vessels, together with its purification and storage aboard.

Not enough has been done in the past on the first of these problems. How easy it has been under the schemes in use by railroads to destroy the purity of water by careless handling during the coach watering process! Consider the facts that previous to 1921 ice was placed directly in the water in coach coolers to chill it and that the methods often followed in ice handling and in safeguarding the sources of the ice itself were questionable. Reprint No. 1162 from the Public Health Reports gives a summary of the results of the efforts of the Public Health Service to have coolers on common carriers remodelled so as to exclude the ice from the drinking water. The following is quoted from that reprint: "This leaves but 1,330 coolers which, at the date of this writing (1927) have not been reported as having been rebuilt to conform with the provisions of Interstate Quarantine Regulations. This low figure represents 1.3 per cent of the total number of coolers reported as existing on cars operating in interstate traffic. It is believed that inquiry at the present time into the status of the few coolers reported during this survey as not being usable under the Interstate Quarantine Regulations will now show them to have been rebuilt."

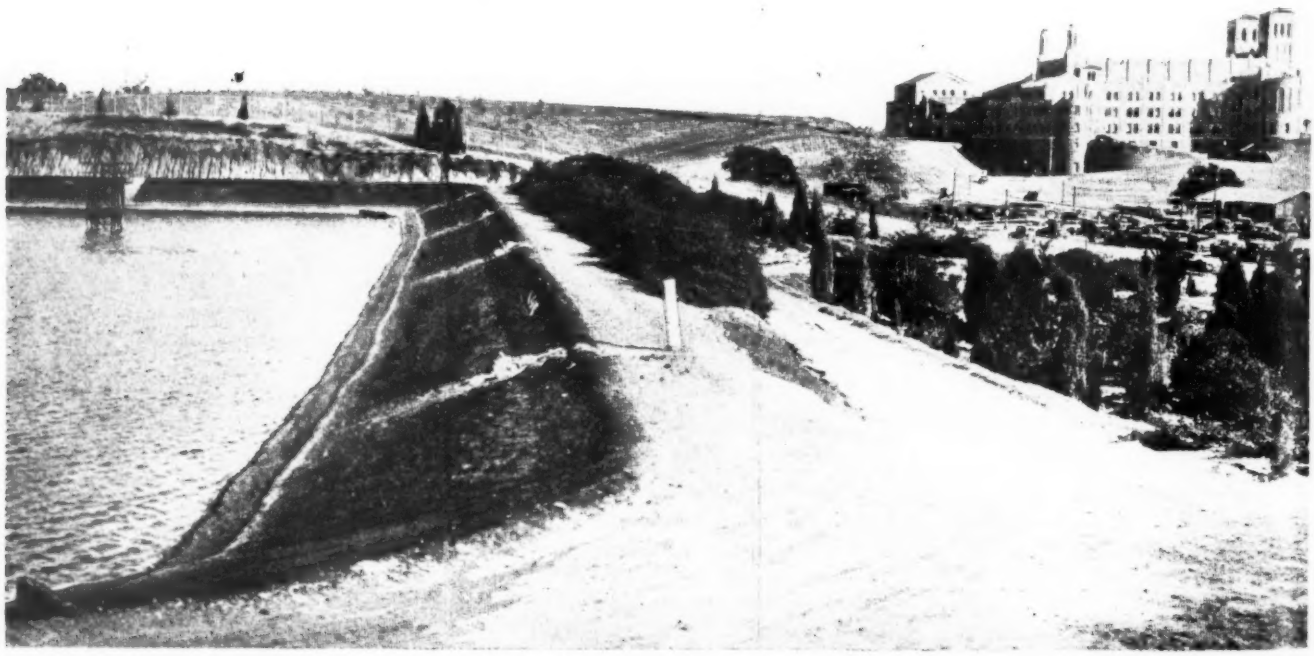
Contamination by Careless Handling.—The effect on the drinking water of careless handling by railroad employees must be taken into account. During the past year my office has been studying by bacteriological methods the actual quality of the water in the train coolers and in so doing has had over 1,360 10 cubic centimeter tubes run through the complete bacteriological tests specified by the American Public Health Association. The percentage of those found to be positive, although not excessive cannot be ignored. The study will be completed during the coming summer. Paralleling this work we have undertaken surveys of practices followed in and facilities used for coach watering. Along a number of the major lines in the southeast, inspection of 73 watering points in 6 states have been completed.

This problem is rapidly making itself felt in the railroad field. Some of the larger companies have taken hold of it on their own initiative and others have acted promptly when the matter was brought to their attention. The American Railway Association is now studying in a comprehensive way the whole subject of railway sanitation and much good should come from this study.

Water Supplies of Vessels.—Let us now consider the many vessels which traverse our coastal waters, lakes and rivers. Since the beginning of supervision of water supplies by the Public Health Service, the entire burden of assuring the continuation of the quality of a good drinking water after it has reached the vessel has been assumed by that Service. This involves a consideration of the methods used to transfer the water from the shore to the vessel and the examination of the complete water supply system on each vessel, including the storage facilities, pumping and distribution works and purification apparatus. One does not think often of the complexity of our large vessels but when it is remembered that many of them carry a number of passengers equivalent to the population of some villages, an idea of the work involved in checking a distribution system can be obtained. When this work was started it was all done by the engineers; now it is handled mostly by a group of engineering assistants, some of whom are employed only in the summer when ship operation is at its maximum. Vessel inspection is arduous but most of the engineers in the service not on research work have served an apprenticeship at it.

The problems of this phase of our activities differ but they may be roughly divided into the following classes: ocean going, river and Great Lakes vessels. The use of overboard water from the Great Lakes introduces an additional complication in that territory.

Like the water certification plan, a vessel certifying scheme was set up which to this day is functioning satisfactorily. As an indication of the



Landscaping on Down-Stream Slope of Sawtelle Pressure Break Reservoir, City of Los Angeles, Calif.

Landscaping on Down-Stream Slope of Dam of Stone Canyon Reservoir, City of Los Angeles, Calif.

magnitude of this work it might be said that in 1929 there were 2,243 vessels in what we call an active status. Seventy-two per cent of that number were acted upon that year. District 2 has only 6 per cent of the total number of vessels but 84 per cent of those were inspected and certified.

Tangible results have been obtained through this work, particularly in the Great Lakes area where overboard water was used with regularity in past years. Recorded official data show that in 1916 there were 70 cases of typhoid fever reported as occurring on vessels in that territory while in 1927 there were but two typhoid fever and three dysentery cases reported. Although the reporting of these diseases is not an exact measure of improvement, it does at least offer encouraging evidence. Both the water and the vessel certification procedures are now supervised and performed by engineering personnel.

Shell Fish Studies.—Drinking water is one of the most important bearers and transmitters of diseases but there are others. Milk has been responsible for quite a number of epidemics and lately shellfish has assumed considerable importance. An article appearing in the Public Health Reports in 1927 cites 26 instances of outbreaks of typhoid fever, gastro-enteritis and cholera in Europe and this country from 1815 to 1926 which could be traced to shellfish. Many of you will recall the outbreaks of typhoid fever in New York, Chicago and Washington in 1924 and 1925, in the study of which the Public Health Service closely involved the oyster. The oyster is a tasty food and should be eaten by more of us. Hence, to assist in maintaining it on the market as a food product, the Public Health Service upon the request of health officers and shellfish dealers undertook to assist in restoring public confidence in its safety as a food product.

The plan evolved to accomplish this, like that already in use in connection with water, is a cooperative one with state health departments. The Public Health Service undertakes by ample field work to measure the suitability and sufficiency of the machinery for and the methods used in doing the shellfish sanitation work in each state. We publish our opinions in the form of a list of certified dealers which is sent out to the entire United States. Where there appear to be deficiencies in a state's methods, personnel or equipment, an attempt is made to correct them. If this is not successful the Public Health Service can no longer assume the responsibility of advising all other states that the results in the deficient state are considered adequate but on the other hand must indicate the contrary by discontinuing activities in that state. In addition to that action, the dealers in that state are removed from the certified list. Through close cooperation with the other states and a number of large cities, the shellfish from a disapproved one are excluded by the others and without a ready market those shellfish cannot be sold easily. As you will see, this brings about remedial action in the dilatory state and the net results is a correction of the deficiencies found.

All of this work is now directed by engineers. Due to the location of District 2 more than half of it is done there and during the shellfish season it becomes a major activity. Field work involves sufficient inspections of shucking houses in each state to permit the formulation of an opinion as to the adequacy of the state's work, checking the activity of patrol forces covering condemned or restricted areas, and reviewing and assisting in the collection of data designed to effect the establishment or release of restricted areas.

To maintain the products of the shellfish industry in a suitable sanitary condition has necessitated much work on the part of the Public Health Service as well as the states. Our records show that during the season of 1928-29 there were 3,192 shucking house inspections made in the seven shellfish states in this area or an average of 443 inspections per month. This is equivalent to 0.6 of an inspection per shucking house per month. To check this work, there were 247 shucking house inspections made by District 2 engineers. These figures indicate that, although we are unable to see every shucking house each year, enough is done to permit the formulation of opinions as to adequacy and effectiveness of state control.

At first glance, one might consider an oyster shucking house not an ideal place for handling a food product often eaten raw. However, by bringing into these house a few simple and elementary sanitary rules and practices, by having them built so that the maintenance of cleanliness is easy and not

difficult, the chance of transmitting diseases has been reduced many times.

Where individuals have entered this industry with the idea of making a permanent business of it and not just a bare living and have re-invested some of their profit in their business as other progressive merchandisers do, the shucking houses are models. Some few plants are almost entirely mechanical with bucket conveyors and moving belts. In such a plant, the handling of the shucked oyster is reduced to a minimum and the facilities for cleansing both the oysters and the plant and its equipment are beyond criticism. Many states have had to provide more adequate facilities and additional personnel to undertake this program. For example, in Georgia where this work is under the direction of the Department of Agriculture, a sanitary engineer who I believe is probably the first one ever employed by a state agricultural department was hired to devote all of his time during the season to their sanitation program. The sanitation plane of this business in all its branches has risen rapidly in the last few years but perfection is still in the distance.

The control activities thus far discussed require more than half our time. They do not demand the skill of the designer or constructor but they do need a degree of mental adeptness as well as firm and tactful handling.

Work for Department of Justice.—This year, at the request of the Department of Justice, the Public Health Service has undertaken the sanitary engineering work for that Department. This involves five large institutions, two of which are located in the southeast. Thus far it has been necessary to supply these two penitentiaries with designs for such devices as a can-crushing and baling machine and an incinerator for combustible material. Plans for new sewerage and sewage pumps and milk pasturization equipment are under construction. A review of building plans, a revamping of the operation of a filtration plant, a study of a sewage treatment plant, and numerous other miscellaneous matters have had to be handled. This type of work presents a variety of problems comparable to those met in state work.

In accord with Service policy similar cooperative work is carried on with the Indian Bureau. All needed sanitation in 104 agencies in the United States is done through the Public Health Service district engineers' offices. One of the problems of my office in that connection has been the design of a new water suply system for the Cherokee Indian Agency in North Carolina.

Sanitary Engineering for National Parks.—In 1921 a plan was arranged between the National Park Service and the Public Health Service for engineering personnel of the latter to do the sanitary engineering work in the national parks. I was assigned to the San Francisco office from where this work was directed, as an assistant engineer. For three years, the summer periods were spent in Yellowstone, Glacier and Rocky Mountain National parks. The problems in all of the national parks at that time were almost overwhelming. Annual increases in travel through them were astonishing and unfortunately the facilities for handling these sudden increases were not adequate. It was almost impossible to build up to the needs.

The scope of work planned for the first summer in Yellowstone is brought out in the Service's Annual Report for 1921. There were included the preparation of designs and estimates for sewerage systems and disposal plants, the measurement of sewage flow at several points to obtain data for additional designs, the ascertainment of the quality of the many small drinking water supplies in the park and the closing up of those found not suitable, the preparation of estimates and plans for mosquito eradication at several points, the location of sorely needed water supplies, and general inspection work. By 1923, two complete sewerage system and treatment plants had been installed and plans had been prepared for similar works at two other points. The other matters mentioned above had been started and in many cases were well on their way to completion. In addition, time and thought had been given to the preparation of a suitable scheme for the collection and disposal of both combustible and non-combustible wastes. This problem eventually was solved by the adoption and installation of incinerators and can-crushing and baling machines.

This work has gone forward. Some of you are probably familiar with the new sewage treatment plant (9) at Grand Canyon National Park which produces an effluent that meets the Treasury Department standards for drinking water. Last June, 120,000 gallons of sewage per day were reclaimed at a cost of less than $100. This amount of fresh water was valued at $300. The net daily saving therefore, is more than $200. Other matters now in the forefront in this national park work include designs of comfort stations and sewage disposal plants for Glacier, a new sewage treatment plant at Yosemite, preparation of plans for remodeling a swimming pool in Yellowstone, and for a suspended sewer line over the Merced River in Yosemite, and recommendations for remodeling an incinerator in Sequoia.

Like all engineering of offices, ours receives the full share of requests requiring special attention and investigation and the usual reports and miscellaneous details take of our time, but the main duties of the engineering personnel attached to district offices are briefly covered herein.

Acknowledgment.—The foregoing is an abstract of a paper presented March 21 at the West Virginia 5th Annual Conference on Water Purification.

Water Softening at Columbus, O.

With the close of the year 1929 the city of Columbus, O., completed 21 years of water softening. The following general resume of this experience is taken from the annual report for 1929 of C. B. Hoover, Superintendent:

Resume of 21 Years of Water Softening

Gallons delivered to city	162,496,000,000
Average gallons per day during period	21,200,000
Total hardness removed in ppm.	26,656,000
Average hardness removed in ppm.	164
Average hardness removed in grains per gal.	9.75
Total tons of lime used	110,972
Pounds of lime per part of hardnes removed per M. G.	8.3
Total cost of lime	$843,356.98
Pounds of lime used per M. G.	1,360
Average price of lime per ton	7.60
Total tons of soda ash used	53,836
Pounds of soda ash per part of hardness removed per M. G.	4.0
Pounds of soda ash used per M. G.	660
Total cost of soda ash	$1,639,122.68
Average price of soda ash per ton	30.45
Total tons of alum used	22,975
Total cost of alum	$311,573.01
Average price of alum per ton	13.56
Total tons of chlorine used	115
Total cost of chlorine	$16,666.94
Average price of chlorine per ton	144.93
Total tons of coke used (since August, 1927)	1,290
Total cost of coke	$7,257.30
Average price of coke per ton	5.61
Total cost of all chemicals	2,817,976.91
Average cost per year during 21 year period	134,160.00

Unit Chemical Cost for the 21 Year Period

	Cost per M. G.	Cost per Part Hardness Removed
For lime	$ 5.18	$0.0316
For soda ash	10.09	.0615
For alum	1.91	.0117
For chlorine	.10	.0006
For coke	.24	.0018
For all chemicals	17.52	.1072

Ohio Water Conference

The 10th annual Ohio Water Purification Conference will be held in Columbus, O., Oct. 14-15. As this year's Sewage Treatment Conference will be held in Dayton Thursday and Friday of the same week, proximity of the conference cities and dates will make it convenient for those who wish to attend both sessions to do so without excess of travel or undue loss of time.

The Water Purification Conference is made up of men directly in charge of water purification plants, who meet annually to discuss the most recent developments in water treatment practice. Officers for the current year are:

O. F. Schoepfle, Superintendent water purification plant, Sandusky, chairman; F. E. Sheehan, Superintendent water works, Portsmouth, vice-chairman J. M. Montgomery, Superintendent water works, Piqua, secretary-treasurer; J. Sheldon Scott, Superintendent water purification plant, Steubenville, executive committeeman-at-large; T. R. Lathrop, Assistant Engineer Ohio Department of Health, editor annual report.

Labor-Saving Equipment on Water Project

Construction Methods and Equipment Used in Handling Earth, Concrete and Forms for the New Howard Bend Filtration Plant of St. Louis, Mo.

A project notable for the number of labor-saving methods and pieces of equipment developed for the handling of earth, concrete and forms was the construction of the new water plant for the city of St. Louis, Mo., situated at Howard Bend on the Missouri River, approximately 13½ miles west of the city limits.

This plant combines an intake from the river with a filtration plant for clarification of the river water. It will have an ultimate capacity of 200,000,000 g.p.d., and its total cost is said to be in the neighborhood of $12,000,000.

In Fig. 2 is shown a ramp-and-conveyor arrangement used for placing the concrete footings of the walls of the 100-m.g. clear-water reservoir. A ramp leads to a portable hopper, mounted on steel wheels and running on a plank track. Trucks backed up the ramp and discharged concrete into the hopper, from which the mix was withdrawn through a gate operated by hand on to a belt conveyor. This conveyor, about 20 ft. long, was inclined at an angle of about 25 deg. with the horizontal. Concrete was discharged from the conveyor belt into chutes, through which it was distributed to the footing forms. The conveyor, built by the General Conveyor Co., was driven by a gasoline engine and was moved along the forms by hand. When it was found necessary to move the hopper, the ramp was raised slightly and the whole outfit was drawn forward by a tractor. Portability was the essence of this arrangement, and it is believed that this scheme was more satisfactory than an attempt to cover the whole area from a single central point would have been.

Figure 3 illustrates setting of the Blaw-Knox wall forms for the settling-basin walls, and also the skip hoist used in pouring the walls. The forms were placed with the aid of the steel gantry, which operated on rails laid on each side of the footing. The inclined hoist was powered by a small gasoline engine.

Figure 4 shows the movable tower used for concreting the walls of the 100-m.g. clear-water reservoir. The ramp was mounted on double-flanged steel wheels, running on 60-lb. rails laid on cross-ties. The bottom 5-ft. section of the Insley mast was hinged, so that it could be raised from the ground when a move was to be made. After each move, this section was lowered, giving a secure foundation on the ground. The tower was provided with a ¾-yd. bucket, operated by a steam hoist. In moving, after the ramp and the bottom section of the tower had been raised, the outfit was propelled by means of a cable running from the hoist to a deadman between

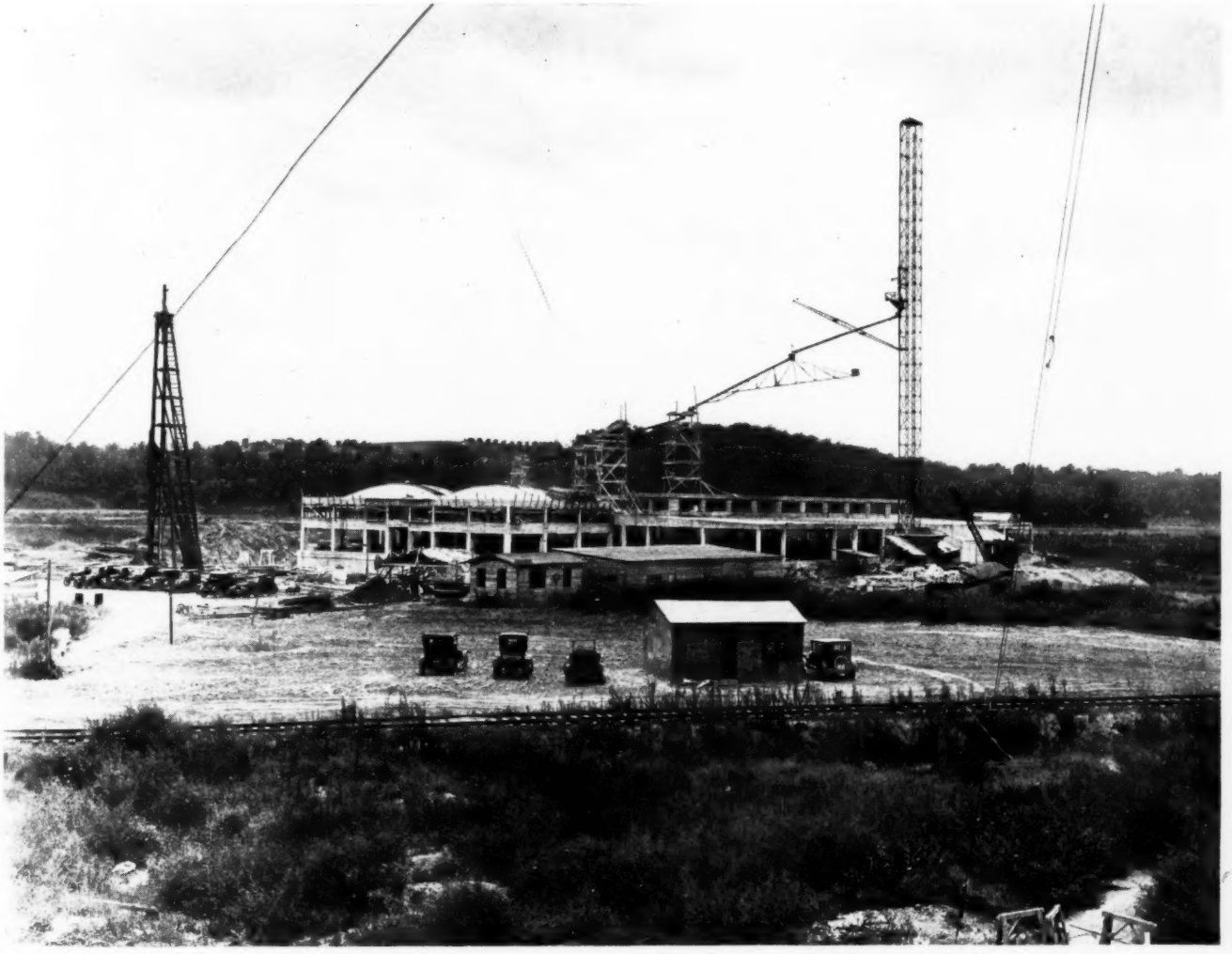


Fig. 1—Tower Used in the Construction of the Howard Bend Filter and Headhouse

Fig. 2—Ramp and Conveyor Arrangement Used for Placing Concrete Footings for Walls of Reservoir

the rails. This photograph also shows the gantry used in placing the forms, and delivery of concrete by means of trucks.

In Fig. 5 is shown the portable ramp and belt conveyor used in placing earth fill back of the walls of the 100-m.g. clear-water reservoir. The conveyor was 36 in. in width and 100 ft. long. Earth was carried in dump wagons drawn by mule teams. The teams ascended the ramp and the wagons were dumped into a hopper. The hopper was provided with a trap-door to allow the passage of the mules. The ramp was mounted on skids and the conveyor on steel wheels running on plank tracks. The outfit was moved along the wall by a tractor. In operation, the hopper discharged on to the belt, which deposited the earth on the far side of the wall. The conveyor was driven by a 50-hp. gasoline engine.

Figure 6 shows a home-made skip hoist used for placing concrete in the boiler house. A small mixer is seen in the foreground. Aggregates were handled in wheelbarrows. In Fig. 7 is shown the tower used for placing concrete in the coagulant house.

Concrete for the Howard Bend plant was mixed at a central plant over a mile away from the site. Aggregates were brought in by rail and stockpiled, pending storage in bins by a locomotive crane. Cement was delivered in bulk and transferred to bins at the plant by a bucket elevator. Concrete was mixed in a 1½-yd. Smith tilting mixer, driven electrically. Proportioning was by volumetric measurement of sand and gravel and weighing of the cement. The strength of the concrete was controlled by the water-cement ratio. From the mixer, the concrete was elevated by means of an Insley

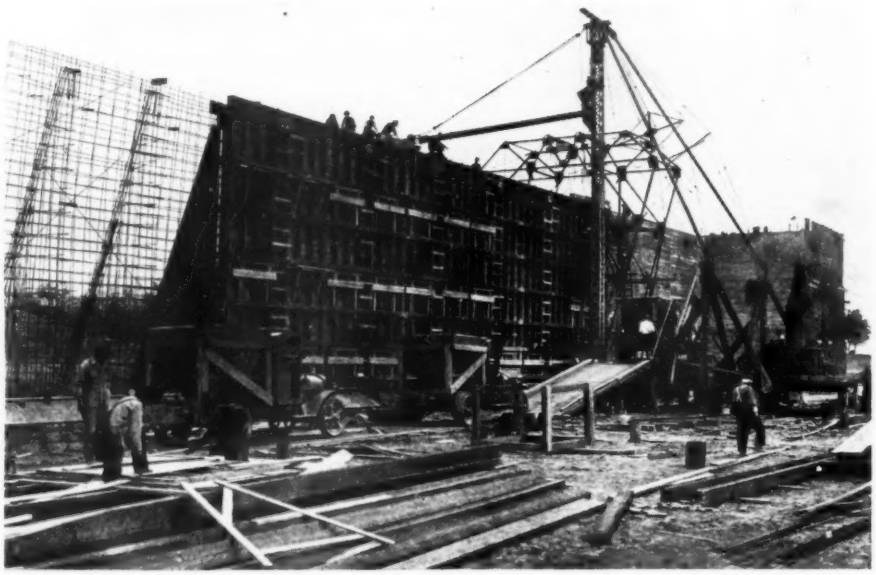


Fig. 4—Movable Tower Used for Concreting the Walls of the 100,000,000 Gal. Clear Water Reservoir

Fig. 3—Setting of the Wall Forms for the Settling Basin Walls; View also Shows the Skip Hoist Used in Pouring the Walls

tower and chuted to a hopper, from which trucks were loaded.

Considerable interest attaches to the construction of the covered basins, the concrete decks of which were supported by precast concrete columns poured at the site. About 1,700 of these columns, which were 14x14 in. in section and about 35 ft. long, were required. The columns were cast in quantities in horizontal forms. Column footings were cast with square holes to take the column bases. The columns were set with a tractor-mounted crane. The deck slabs were doweled to the column heads.

Construction of the intake necessitated the building of a cofferdam 110x 140 ft. in area. Steel piling was used in the construction of this cofferdam. A number of concrete piles were driven to form a foundation for the intake building.

Before construction of the plant was begun, considerable control work in connection with the river banks was

required in order to prevent encroachment of the stream upon the plant site. A revetment about a mile long was built about a mile above the plant, at a point where it was necessary to guard against scouring during high water. The bank was given a uniform slope by means of a hydraulic gun, and mats were sunk and held in place by rocks.

Between the lower end of the revetment and a point below the plant intake, a number of retards were built out at right angles from the shore. The retards are placed in groups of three, chained together. Trash of various sorts collects behind the retards and the resultant slowing-up of the current causes a deposit of sediment. Thus the bank is afforded a continual protection.

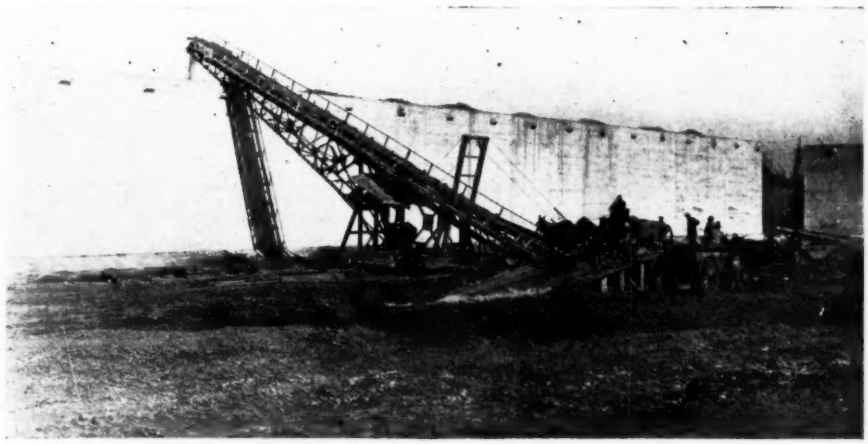


Fig. 5—Portable Ramp and Belt Conveyor Used in Placing Earth Fill Back of Walls of 100,000,000 Gal. Clear-Water Reservoirs

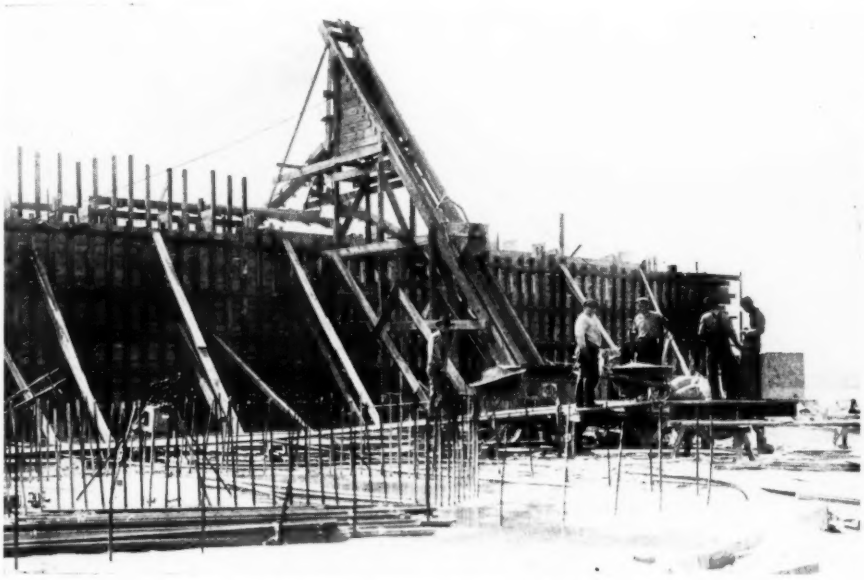


Fig. 6—Home-Made Skip Hoist Used for Placing Concrete in Construction of the Boiler House at Howard Bend Plant

The Howard Bend plant was designed by the engineers of the Water division of the Department of Public Utilities, under the direction of L. A. Day, water commissioner. Construction of the plant was divided among a number of firms of contractors.

Color and Organic Matter Removal

During the fiscal year ended June 30, 1929, an important piece of research work conducted in the laboratory of the Reservoir and Pumping Plants Division of the Department of Water and Power of Los Angeles, Calif., was a study of the Harbor District water in an effort to devise a treatment process to remove color and organic matter. The following note on this work is taken from the 28th annual report of the Board of Water and Power Commissioners.

Owing to the characteristics of this water, the problem was a complicated one necessitating much investigation. Conventional method of water treatment failed almost completely and combinations of several chemicals which would do the required work were too expensive and too cumbersome to be practicable. It was finally found that ferric chloride used by itself and in comparatively small doses was sufficient to remove all of the color, rendering this water physically perfect. A small experimental sand filter was erected in the laboratory and operated for some time with such uniformly satisfactory results that it was decided to build an experimental treatment plant at Wilmington for the purpose of refining the details of treatment. Designs for this plant have been completed and its construction ordered. It will handle, at conventional rates, 72,000 gal. of water per day and it is believed, will give valuable knowledge and experience in the treatment of this unusual water.

Fig. 7—Tower Used in Placing Concrete for the Coagulant House for the New Howard Bend Water Works Plant of St. Louis, Mo.

The Well Driller and the Water Works Field

Advances That Are Being Made in the Methods of Drilling and Finishing Wells for Public Supplies

By A. G. FIEDLER

Hydraulic Engineer, Division of Ground Water, U. S. Geological Survey

IN considering the facts that about half of the people of the United States use water supplied by wells and that about three-fourths of the cities and villages that have waterworks draw upon underground supplies, it becomes apparent that the water-well driller is engaged in a business that is intimately associated with the health and well-being of the public. It is estimated that there are about 8,000 cities and villages in the United States that have public waterworks and about 6,000 of these are supplied by wells. The largest well system in the country is the one which formerly supplied most of the water for Brooklyn, before that city became a part of the greater New York; it has a capacity of about 100,000,000 gal. a day. Many of the smaller systems, which supply innumerable villages scattered throughout the country, have a daily capacity of only 100,000 gal. or even less. Altogether about 17,000,000 people are supplied by public waterworks that derive their supply from wells.

Twenty Thousand Drillers in U. S.—I have estimated that there are about 20,000 drillers in the United States, of whom probably more than 10,000 are actively engaged in the business. During an average year many thousands of wells are drilled, representing an expenditure of many millions of dollars. Although the number of wells drilled especially for municipal water supplies represent probably less than 5 per cent of the total number drilled each year, yet these wells involve a much greater percentage of the annual expenditure because they are generally of more than average size and depth. Unfortunately no complete survey of the well-drilling business has ever been made, and it is difficult to make a reliable estimate of the extent of so widespread a business without more basic data.

The men engaged in well drilling have much in common with the members of the waterworks profession. By reason of the fact that the ultimate goal of both is the same—namely, that of furnishing an abundant and convenient supply of pure water to the people—the well driller can appreciate some of the difficulties of the waterworks man in getting the water delivered to the ultimate consumer. Contrary to the conception which prevails in some quarters, the business of drilling wells is not without its difficulties and hazards. In fact, it can be safely said that this business has more than its just share of hazards of failure, because the driller must conduct his work from the surface while his tools are working away unseen several hundred or thousand feet beneath the surface. Under such conditions many circumstances can arise that can ruin the patient work of many days and threaten the completion of the job. Because of these extra hazards, which are an integral part of the business, the experience of the man behind the drilling machine, is especially important.

Well Drilling Has Many Hazards.—As an illustration of some of the difficulties encountered in deep-well construction I may mention that recently one of the deepest cable-tool fishing jobs on record was being done in a well at a depth of 9,379 ft. Though this particular job arose during the construction of an oil well and was done at a much greater depth than that usually involved in water-well construction, it is a rather impressive illustration of the fact that the drilling of wells is a highly technical business, requiring men of skill and mechanical training.

Even in an area that has been thoroughly explored by other wells, which have disclosed the character, thickness, and water-bearing properties of the different formations, the problem of obtaining additional supplies of ground water is not necessarily a simple one, although such information in regard to any locality is indeed of great value. In the final analysis the driller' task is to construct the well in such a manner that it will not only make a sufficient quantity of water of suitable quality available but also yield the greatest quantity of water at the least expense.

The Important Feature of Drawdown.—This fact suggests a most important point, which is generally overlooked by engineers and water-supply men in the specifications for the construction of a well. Usually the specifications are centered around the quantity of water to be obtained from the well, and no mention is made of the equally important feature of drawdown. In view of the fact that, within certain limits, the yield of a well increases according to the drawdown, it becomes evident that the rate of yield alone gives insufficient information for judging the capacity of a well and that the amount of drawdown or the specific capacity of the well should also be given. For instance, if a well yields 250 gal. a minute under a drawdown of 10 ft., its specific capacity or rate of yield per unit of drawdown is 25 gal. a minute per foot of drawdown. By doubling the drawdown the yield is also practically doubled, and so on. It is evident, therefore, that the yield from any well could be increased by installing a pump of greater capacity, but because the drawdown would become greater under such increased yield the cost of pumping at the increased capacity might be prohibitive.

The specific capacity of a well that ends in creviced or fissured rock can not be controlled to any great extent by the driller, because it is governed largely by the number and size of the crevices that are encountered by the drill, but the specific capacity of a well ending in gravel and sand can generally be greatly increased through proper methods of development. This problem is gradually receiving increased attention by engineers and water-supply men, for it has a vital bearing on the economical operation of the water-supply system. The qualified well driller also realizes the importance of drawdown and will gladly assume the responsibility of obtaining the greatest possible specific capacity if he is properly recompensed for constructing a well of high efficiency.

Determining Feasibility of Ground Water Supply.—In the smaller municipalities, where detailed geologic examinations have not been made, the problem of determining the feasibility of using a ground-water supply or of obtaining an additional supply is frequently placed largely with the well driller. In territory in which the ground water is contained in the joints and crevices of hard rock wells of small yield are not uncommon. Where the ground water occurs in the interstices of unconsolidated material the driller is confronted with the problem of separating the water from the sand—a task which may be very difficult but which if properly done may result in wells of large capacity. Other difficulties may arise in attempting to drill a straight hole through beds that are tilted at a high angle or to carry the hole through beds of quicksand that readily heave into the pipe. All these problems are constantly being encountered in the construction of wells, and their solution requires the exercise of great ingenuity and patience.

The elements of skill and experience, together with adequate equipment, play a vital part in the successful completion of work of this character. Although the usual run of drilling difficulties are to be expected in any job, at times unforeseen troubles may occur

and seriously interfere with the early completion of a well project. These difficulties fall chiefly in the class of "fishing jobs." They involve the recovery of tools that have been lost in the hole, the removal of defective pipe or casing, and the recovery of tools that have wedged fast and can not be readily withdrawn. Many of these difficulties can be avoided by the use of good equipment and the exercise of skill in handling tools, but even the most skilled operators are not immune from them.

It can therefore be readily seen that the well driller is confronted by many problems and difficulties which can not be fully anticipated when the specifications for a well job are drawn up. Obviously it is unfair to require the driller to guarantee a given quantity of water under specifications that state in detail the methods and manner in which a well shall be constructed, without permitting him to exercise his own judgment on problems of construction.

How the Driller Can Assist the Water Works Man.—There are three particular fields in conjunction with groundwater supplies in which the driller can be of real assistance to the waterworks man. One of these fields has to do with the quantity of the water, another with the quality, and the third with the method of constructing and finishing the well.

Most growing communities are confronted by a recurring problem of a shortage of water supply. Favorable location in reference to transportation, topographic features, and a prosperous surrounding country may provide conditions that would promote a marked increase in the growth and wealth of the community, but without an adequate water supply of suitable quality to take care of such expansion the prospects for continued development are greatly curtailed. Because the larger cities require such enormous quantities of water to satisfy their needs, they are continually having to go farther afield to obtain adequate supplies—many of them now going 50 or 100 miles or even more than 200 miles. The expense of such an undertaking is far beyond the capacity of the small municipalities, and of necessity they are limited to supplies that are closer at hand. An adequate source of surface water may not be readily available, or the expense of treating the surface water in order to make it fit for domestic use may be great, so that attention is given to the possibility of developing an adequate ground-water supply. Under such circumstances the driller can make a real contribution to the welfare of the community, for by means of test drilling or literally prospecting for water, just as the valuable minerals of the earth are prospected for, he may be able to locate groundwater supplies that have previously been passed by unnoticed or considered inadequate.

The demand for water of low mineral content is a problem that confronts many of our municipalities today. Large quantities of water that will be satisfactory for boiler use are required, and the selection of sites for plants engaged in special manufacturing processes is largely based upon the availability of a water supply of high quality. Increasing attention is also being given to the hardness of water used for domestic supply, because soft water in the home results in material savings in the consumption of soap and is otherwise much more satisfactory for domestic use.

The Wells at Canton, S. D.—The value of the services of the well driller in obtaining a water supply of higher quality are well illustrated by the results of work done in the vicinity of Canton, S. D., where soft water was discovered by the drillers in the Dakota sandstone and where formerly the supply had been obtained from terrace gravel that yield very hard water.

The third named field in which the driller can be of particular assistance to the waterworks man is more or less closely related to the problems of quantity and quality. It involves not only the hardness but also the sanitary quality of the water, for the method of constructing and finishing that is used has a vital bearing upon the problem of preserving the original purity of the supply.

Preventing Well Contamination.—I have been informed that considerable trouble has been experienced in this state with contaminated water from shallow depths running down the outside of the casing into the well. The usual methods of preventing such contaminated water from entering the well at the top of the casing, by tight sealing and a concrete platform or covering are relatively simple in application, but where they are not effective the problem is largely one of sealing the casing beneath the surface so that contaminated water can not percolate from one formation to another and hence enter the well. Cement is an excellent material for this purpose, and fortunately satisfactory methods have been developed for adapting it to the needs of water-well construction. Practically all the methods of cementing wells have been developed in the drilling of oil wells, where difficult water problems are frequent, though none of them are more important than the problem encountered in water wells of protecting the purity of water used for domestic supply.

In water-well construction where cementing materials are not used, objectionable water in overlying beds are normally excluded by seating the casing in a relatively hard and impervious stratum, thereby shutting them off. Where this is impossible, packers are frequently used, but in view of the fact that the packing material is normally subject to deterioration this method is not recommended for the best type of construction. In wells drilled by the rotary method, heavy, mud-laden fluid is circulated behind the casing and serves a beneficial purpose in preventing percolation of water behind the casing and in delaying deterioration resulting from the action of corrosive waters. In many localities it is impossible to find a hard and impervious formation upon which to set the casing and is thus difficult to prevent the percolation of water along the casing and into the well. Under such conditions cement properly applied will prevent the entrance of the contaminating waters.

Methods of Cementing Wells.—Three methods of cementing wells are in use—the dump-bailer method, either with or without the use of "cement plugs"; the tubing method, without plug or with one plug; and the casing method, with plug above and below cement or without plugs.

The dump-bailer method of cementing is probably the simplest and requires the least amount of special equipment. In this method cement is placed in the bottom of a well with a dump-bailer after the casing has been raised from its seat. The casing is then lowered after it has been filled with water and sealed or the lower end has been closed with a suitable plug. As the casing is lowered the cement is forced up on the outside of the pipe and is permitted to set.

In the tubing method the cement is pumped into the well through tubing after circulation has been established. To prevent the cement from rising between the tubing and the casing suitable packing devices are used. The tubing method may be used either with or without a plug between the cement and the wash water that is pumped into the well to carry the cement up on the outside of the casing.

The casing method is more or less a variation of the tubing method and practically amounts to using the casing itself instead of the tubing. This method may also be used either in conjunction with one or two plugs between the cement and the water or without suitable barriers separating the cement and the water.

Asphalt As Well Sealing Material.—Asphalt has not yet been widely used for sealing water wells, but this material offers a special advantage in sealing wells that yield water under artesian pressure. In using cement the movement of the water must first be prevented, as otherwise the cement will wash away and will not form a tight seal. Asphalt, however, even before it sets, is impervious to water. When the heated asphalt comes in contact with water the outside of the material takes a partial set while the inside portion remains in a more or less fluid state. By controlling the temperature and the pressure under which the asphalt is placed, openings which con-

tain water in motion can be tightly sealed, thereby preventing the entrance of pollution into the well or the loss of water under artesian pressure.

It would appear that some of these methods might be used to good advantage in Indiana and would largely prevent the contamination of waters of good quality. Some of them can also be adapted to overcome contamination in wells that have been completed for some time. Every such well, however, must be considered as an individual problem, and thorough study should be given to all the factors that bear upon its solution.

Acknowledgment.—The above is an abstract of a paper presented March 21st at the joint meeting of the Indiana Water Well Drillers and the Indiana section of the American Water Works Association. It is published with the permission of the Director of the United States Geological Survey.

Pumps Hung from Cables Dewater Dam Site

Pumps suspended from cables stretched across a canyon were used by the General Construction Co., of Seattle, Wash., to remove water from the site of the dam now being constructed at Owyhee, Ore. The construction of the Owyhee dam is a $17,000,000 project undertaken by the government in the extreme eastern part of Oregon, near the border of Idaho, in Malheur County. This involves the building of a concrete dam across the Malheur River to a height of approximately 250 ft., having a length at the crest of some 1,500 ft. and backing up the river for 52 miles. The stored water will be used to irrigate a large fertile area extending from Nyssa, Ore., to Ontario and Vale, covering some 120,000 acres.

The diversion of the river necessitated the construction of a tunnel 25 ft. in diameter and 3,000 ft. long through solid rock. With this completed and the river diverted from its old channel, it was necessary to remove the water remaining at the dam site in order to begin construction of the dam foundations.

Two electrically-operated pumps were furnished for this purpose by the Byron Jackson Co., each a No. 3-A Deepwell unit with 6 ft. of column and direct-connected to a 75-hp. General Electric induction motor. These pumps were suspended on cables stretched across the canyon, and were raised and lowered by means of a winch situated on the platform where the pump was mounted. General Electric magnetic control was used to start and stop the pumps, push-button stations being placed on the platform where the pump attendant was stationed. This made it unnecessary to mount heavy starting equipment on the platform, which had to be raised and lowered to meet the water conditions encountered.

The two pumps together handled almost 5,000 g.p.m. As one pump discharged through a 500-ft. line of 10-in. pipe, the friction from this and from a gate valve in the line brought the total head on this pump close to 120 ft. As a result the 75-hp. pump motor was constantly overloaded, handling a load of 90 hp. Conditions were better at the other pump, whose motor had but a 45-hp. load. The overload on the first pump was corrected by the installation of a medium-capacity impeller.

Fold Blueprints "Face Out"

When folding blueprints for filing, it is a good plan to fold them "face out." By doing this, time will be saved in searching for a print. In most cases the print can be folded so that the title will show, however, a glance at the outside will usually identify the print if one is at all familiar with it. A possible disadvantage of folding prints this way is that a portion of the print is more easily soiled, but this is not an important consideration unless the print is to receive rough handling.

Left—General View of Canyon at Owyhee Dam Site. Pumps Are at Work in Sump Close to Dragline. Right—Close-Up of Two Dewatering Pumps. The One in the Foreground is Pumping Out the Hole and Discharging into the River Below the Lower Cofferdam. The Other Is Connected to a Hydraulic Nozzle Which Is Used for Sluicing Earth and Loose Rock Off the Canyon Walls.

FILTRATION PLANTS

A Section Dealing with Their Design, Construction and Operation

Conducted by JOHN R. BAYLIS, Associate Editor
Filtration Engineer, Bureau of Engineering, Chicago, Ill.

Washing Rates for Rapid Sand Filter Beds

In discussing the washing of filter beds it is realized that this is a subject in which there is probably more differences of opinion than most anything else in connection with rapid sand filtration. How to keep such beds in good condition has perplexed filter operators from the very beginning of this type of filtration and more especially since the abandonment of mechanical rakes years ago when we began to build rectangular filter beds. Taking the sand out of beds that are in bad condition, breaking up the clogged places, and restoring the beds to good condition, only to let them get bad again and then repeat the procedure, is not a solution of the problem. Yet this is what we see done in the majority of the rapid sand filtration throughout the country.

Efforts to Solve Filter Bed Troubles Have Not Been Along the Right Line.—It does not seem to have occurred to many that they have been working along the wrong line in attempting to solve filter bed troubles. Almost every kind of filter bottom conceivable has been offered by someone as a solution of the problem, and yet we are not much better off in regards to the solution of filter bed troubles than we were when the first filtration plants were constructed. In fact, we are worse off than when mechanical rakes were used. There seems to be an opinion firmly fixed in the minds of practically all filter plant designers and operators that someone will eventually design a filter bottom that will keep the sand beds in good condition regardless of the water being filtered. If one will give the matter a little more intelligent thought it is believed that we can see this is impossible. What are we trying to do when we wash a filter? If it is to cleanse the bed of the suspended matter which has been filtered from the water, then what are the factors that will produce the maximum cleansing? Some types of filter bottoms very likely will give better distribution of the wash water than others, but an even distribution of the wash water is not going to solve filter clogging troubles in most of the filtration plants. If there are defective bottoms in some plants, replacement of the bottoms with better ones should result in improvement in these plants, but this does not mean that the beds are going to keep in good order if there is any material tendency to clog. A bottom of the proper design is one essential, but it is only one of several essentials. What we have been trying to do heretofore is to solve the filter clogging problem by working almost exclusively on one of the essentials that in reality was solved almost at the beginning of rapid sand filtration, that is, even distribution of the wash water.

Character of the Water Has Greatest Influence on the Tendency of the Filter Beds to Form Clogged Places.—It should be evident from the various articles published by the writer that he regards the character of the water as having great influence on the tendency of the filter beds to get in bad condition. There may be two plants in which everything is equal except the water, yet the condition of the sand beds in the two plants may be quite different. Neither aluminum hydroxide nor ferric hydroxide alone will adhere to sand grains with a force that cannot be knocked loose with very slight agitation of the sand. It is the presence of other compounds naturally in the water that causes the coatings to form. In most instances organic compounds are the chief source of trouble. Some organic jellies will build up on the sand grains so toughly that it will require a force probably one hundred times greater to remove than is required to remove precipitates of aluminum hydroxide. Where there is manganese in the water the coating may be built up still more toughly. This is why some of the best operated filtration plants in the country have excessive filter clogging troubles.

Where standard practice has been followed in the design and operation of a filtration plant and there is considerable trouble from filter bed clogging, it is not the filter bottom, size of sand, rate of wash, nor the coagulant used, but it is mainly the character of the water that produces the trouble. These factors, if deviating from customary practice, may have an influence, especially the size of sand and rate of wash; however, such factors do not vary enough in most plants to account for the great difference in the tendency of the beds to clog. With coarse sand and a high rate of wash a greater cleansing force can be produced than with finer sand and a lesser rate of wash. With the same kind of filter bottom and using the same kind of coagulant, some filter beds with sand of 0.35 mm. diameter for the 10 per cent size and a washing rate of 15 gal. per square foot per minute will keep in good condition while others with sand of 0.5 mm. diameter and a washing rate of 20 gal. will get in very bad condition. The cleansing force with the coarse sand and higher rate of wash is much greater than the finer sand and lower rate of wash. In fact it may be two or three times as much, yet it is not sufficient to keep the beds in good condition when filtering waters of certain characteristics. In the face of such facts, is it not time that we direct our efforts to solve filter bed troubles along lines that produce a greater cleansing force?

More Agitation of the Sand Needed.—The agitation of the sand grains must be sufficient to knock loose most of the solid or gelatinous matter adhering to the grains and to break up all masses of coagulated matter to a size that it is washed away with the wash water. The only thing the filter bottom can do towards keeping the bed clean is to distribute the wash water uniformly under the bed. When this is done it is everything a filter bottom can possibly do, and any bottom that does this is just as good as another bottom. The promoters of the patented types of bottoms of course believe they have the only bottom that actually gives even distribution of the wash water. Some of these bottoms probably are better than others in giving good distribution of the wash water, and the better types should be used; but if one bottom produces a 5 per cent better cleansing effect due to better wash water distribution than another, and it requires a cleaning force four times greater for one bed than another to keep them in good order, certainly the 5 per cent difference is a

long way from accomplishing what is desired.

Increasing the Washing Rate Produces Greater Agitation.—A washing rate that puts the sand just in motion produces a certain cleansing force that may be sufficient to keep the beds in some plants in good condition. It is evident that the size of the sand grains, their specific gravity, and the temperature of the water influences the amount of water necessary to put the sand in motion. The finer or lighter sand being near the surface it is put in motion with a lesser rate than the coarser sand near the bottom, and a washing rate that puts all the sand in motion gives the beds an expansion of from 15 to 20 per cent. Increasing the washing rate over the minimum to just put all the sand in motion may increase slightly the rubbing or abrasion force, but it increases the motion of the sand grains or the agitating force quite materially and causes the sand grains to strike each other more frequently and with greater force. A rate is eventually reached in which additional wash water applied from underneath the bed probably will not increase the tendency to knock the suspended matter loose from the sand grains, though the higher rate will wash away more of the small mud balls or masses of coagulated matter.

The farther the sand grains are spread apart in washing over that necessary to give considerable agitation, the less will be the scrubbing effect. The grains may be in a more rapid state of motion, but they have a greater distance to travel to strike other grains. The point where the cleansing effect due to scrubbing or abrasion is actually reduced in a filter bed probably is a washing rate higher than now generally used. There is no way of actually measuring the scrubbing force produced by washing a sand bed and definite values cannot be set. When the wash water is all applied from underneath the beds, as is the case for practically all filtration plants, it seems probable that the maximum rubbing force (the actual pressure two grains press against each other as their surfaces rub) is produced when the bed is just in a state of fairly good motion, though the more rapid motion of the grains at higher rates may actually scrub off more of the adhering matter even if the scrubbing force is a little less.

The agitating force may be assumed to be the force at which the individual grains are moving about and knocking against each other. This force increases as the rate of wash increases, though not in a direct ratio of the increase. When the bed is put just in motion the movement of the grains is very slow and they do not strike each other so often nor with a very great force. As the bed becomes expanded greater the grains are at a greater distance apart and have a chance to gain some momentum before they strike other grains. Friction of the water prevents more than a certain force being produced, unless the water itself is put into a state of considerable turbulence. It is evident as the bed becomes more and more expanded that a point is reached in which fewer grains are striking each other than if it was not expanded so greatly. In other words, a rate can be produced in which the agitating force is actually reduced as well as the scrubbing force, though this point is probably at a much higher washing rate than for the maximum scrubbing force. When the tendency to cleanse the sand grains is compared on the basis of the wash water used, there is a maximum cleansing effect at a certain rate which will vary considerably with the size and specific gravity of the sand grains, temperature of the water, and the tendency of the suspended matter to adhere to the sand grains. Experiments indicate this maximum to be a washing rate higher than is now generally used.

Experiments at Baltimore.—When the writer perfected, in 1923, the first glass tube filter used extensively for experimental work, many observations were made on washing filter beds. The glass tube filter showed that for small size tubes, rates of washing greatly in excess of what was being used at that time in large filter beds could be used. It was not until a rate of about 35 gal. per square foot per minute was reached that the fine gravel became disturbed. A rate of 17 gal. had been used in the large filter beds at Baltimore for several years prior to this, and we were aware that the beds would stand a higher rate than this when in good condition. Experiments were run on a few of the large filters in the plant in which the wash water valves were opened wide. The writer does not have a record of the rate this gave, but he is under the impression it gave about 19 to 20 gal. per square foot per minute. When the beds were in good condition we saw no ill effect from the high rates, but this rate did not prevent clogging. As there was considerable danger of disturbing the gravel when clogged places formed, we returned to a rate somewhere near 15 gal. The significant fact of the Baltimore work was that there appeared to be nothing that could be done in the way of increasing washing rates or time of wash that had a material influence on reducing the clogging tendency of the filter beds. Rates as high as have recently been suggested were not used, but we did use rates high enough to give a sand expansion approaching 50 per cent. The Baltimore water has a great tendency to cause filter bed clogging and there is no size sand and no rate of wash within the bounds of what may be used that will prevent clogging in this plant.

Experiments at Detroit.—The most recent contribution to our knowledge of washing filters has been made by Hulbert and Herring [1] at Detroit. They recommend washing at a rate that will give about 50 per cent expansion of the sand bed. Setting the sand expansion as the guide for determining the rate of wash to be used is probably a distinct advance over present methods, though the writer is of the opinion that such a guide will never be used as a routine procedure. About the best we can expect is for the various filter plant operators to determine about what sand expansion they would like to have and set their wash water valves or washing rates accordingly. Even this will be a distinct improvement over no guide.

Study of Filter Washing Rates.—To see if there is any justification for the 50 per cent sand expansion as recommended by Hulbert and Herring, considerable study has been given to filter washing rates. Figure 1 shows tests on a typical filter sand with a glass tube filter about 1¾ in. in diameter. It will be noted that the expansion is nearly a straight line function of the washing rate, the expansion starting at a rate of about 7 gal. per square foot per minute for the particular sand used. It also will be noted that just before enough wash water is added to start the bed expanding there is an actual shrinkage of the bed. This is due to the sand grains working themselves together to form a smaller void area. This probably will occur to a much less extent in a large bed where the wash water cannot be cut off rapidly.

It required a washing rate of 7.5 gal. to put a little of the top sand in motion with the sand used to produce the curves illustrated in Fig. 1. At a rate of 15 gal. per square foot per minute, which is approximately 24 in. vertical rise per minute, there was an expansion of 6 in., or nearly 25 per cent. Most filter beds are now being washed at this rate; however, most of them probably have finer sand and there is greater expansion. With 6-in. expansion the movement of the sand was very slow, but the entire bed was in motion. It was evident the maximum agitating or even cleansing force was not reached with this rate for the grains did not have free movement and they merely rubbed slowly against each other. In fact the agitation was very little compared with what it was at higher rates.

It is not possible to measure the agitating force produced in washing filters in terms of something that can be plotted on a diagram like the expansion of the bed. About the only thing one may do is to rate the agita-

[1] Studies on the washing of rapid sand filters. J. Am. Water Works Assoc., 21:11, 1445-1513, November, 1929.

tion as none, little, fair, considerable, etc. Assuming the point where maximum agitation appears to be produced by applying all the wash water underneath the bed to be 100 per cent agitation, a curve might be plotted by assigning certain percentages of the maximum for lower rates of washing. In the glass tube filter with the particular size sand grains and depth of the bed, the maximum agitation of the sand appeared to be when the washing rate was about 30 gal. per square foot per minute, or approximtaely 48 in. vertical rise per minute. At 15 gal. washing rate the agitation appeared to be only about 10 to 15 per cent of the maximum.

It must be remembered that there are two forces tending to cleanse the sand—agitation, and sand grains rubbing against each other. As stated, the rubbing force probably is greatest when the sand is just in fairly good motion. Even though this force may be considerable, very slow motion of the grains would take a long time for the sand to be cleansed of the adhering matter. The curve for the agitating force shown in Fig. 1, while only approximate, is not greatly in error. The force at least varies in the general direction of the curve. It will be noted that 50 per cent agitation was obtained at a washing rate of about 20 gal. per square foot per minute. Now it would seem unwise to stop at 20 gal. when by increasing the rate to 23 gal. the agitation is increased to about 75 per cent of the maximum. Perhaps the curve is a little overdrawn and it does not rise so rapidly at the middle point. What is intended to bring out with the curve is the fact that about the middle point of agitation the force is increasing at a more rapid rate than the expansion.

Fifty Per Cent Sand Expansion a Very Good Criterion for Washing Filter Beds.—With the particular sand used in the experiments illustrated in Fig. 1 it was not until there was 35 to 40 per cent expansion before the grains began to have a movement independent of the surrounding grains. At lower rates the sand moved more or less together, not like it was bound together but the motion of the grains were not independent of the surrounding grains. The writer's observations point strongly to the 50 per cent sand expansion suggested by Hulbert and Herring as producing about the desired agitation for good cleansing of the bed. These remarks refer to agitation only, and it must be remembered that the scrubbing or abrasion force drops off as the sand grains are forced farther apart. It is likely, however, that this force has not dropped off materially at 50 per cent sand expansion. The fine gravel begins to be disturbed at a washing rate of about 35 gal. per square foot per minute when the temperature is about 15° C., and the washing rate should not approach this too closely. With sand less than 0.4 mm. diameter for the 10 per cent size it is likely that a sand expansion of 50 per cent or slightly greater may be used without danger of disturbing the gravel, providing there are no clogged places in the bed. With larger size sand a less expansion should be used, but the scrubbing or abrasion force of the coarser sand is greater than the fine and the bed may have an even greater cleansing force.

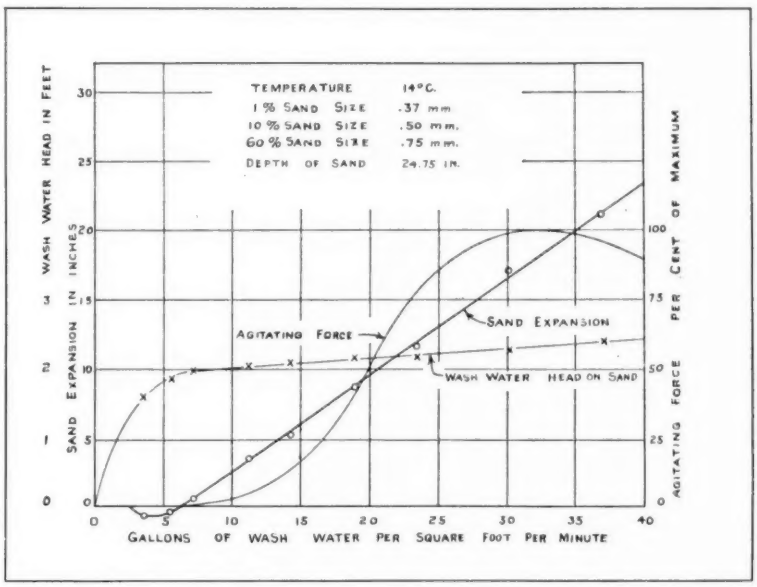

TEMPERATURE 14°C.
1 % SAND SIZE .37 mm
10 % SAND SIZE .50 mm.
60 % SAND SIZE .75 mm.
DEPTH OF SAND 24.75 IN.
WASH WATER HEAD IN FEET
SAND EXPANSION IN INCHES
PER CENT OF MAXIMUM
AGITATING FORCE
SAND EXPANSION
AGITATING FORCE
WASH WATER HEAD ON SAND
GALLONS OF WASH WATER PER SQUARE FOOT PER MINUTE

Fig. 1—Tests on a Typical Filter Sand.

The motion of the sand in a large filter bed being washed is really a series of boils, the water and sand rushing upward in places and downward in other places. Until there are fairly long tests on large size filter units the writer believes it would be unwise to use washing rates much in excess of 20 gal. per square foot per minute, or approximately 32 in. vertical rise per minute. This happens to be almost exactly the rate suggested by Hopkins [2], which was determined in another manner. In the face of what the agitating curve shows for 23 gal. per minute it would seem that one might risk this rate where the tendency to clog is fairly great, yet it is evident that such a rate would be disastrous to a bed with clogged places.

It Is Not Possible to Wash at a Rate That Will Keep Filter Beds in Good Condition When the Tendency to Clog Is Great.—Chief consideration in this discussion has been given to the factors producing the maximum cleansing force in sand beds where all the wash water is applied from underneath. Whether or not this maximum cleansing force, if it were possible to apply it, will keep the sand beds in good condition for all plants in the summer months is doubtful. The writer does not believe it will, even for the majority of filtration plants. By using washing rates that will give a maximum cleansing force, perhaps 25 to 30 per cent of the filter beds within the United States could be kept continuously in good condition, and those of many others could be kept in better condition than they are now being kept. This would be a marked improvement over existing conditions, but a long way from the ideal.

Additional Force Is Necessary to Keep Filter Beds in Good Condition.—For the past 6 or 7 years the writer has been advocating the solution of filter bed clogging troubles by the application of a force that will keep them in good condition almost regardless of the clogging tendency of the water. So far no one seems inclined to resort to anything other than applying the wash water underneath the beds. The work at Baltimore and more especially the excellent work of Hulbert and Herring at Detroit calls attention to the fact that not enough force is now being applied into the beds. The writer feels that he is on the right track with the surface wash and that something of this nature will eventually have to come into use. If it requires a certain washing force to keep the sand beds of a filtration plant handling a certain water in good condition and it is not possible to apply the necessary force from underneath the bed, what would you do? What we are now doing is to let the beds get in bad condition and then restore them to good condition by digging out the clogged places and washing the sand by some expensive method. As has been stated, this merely corrects a bad condition only to let it get bad again. Surely this is not the solution of filter bed troubles.

[2] Control of washing at rapid filtration plants. Eng. News-Record, 102: 841, May 23, 1929.

Charges for Standby or Breakdown Service

A Discussion of the Principal Factors Entering into the Entire Rate Structure

By J. C. STIPHER

Indianapolis Power & Light Co., Indianapolis, Ind.

THE effect of a maximum demand on a system is not the same with all utilities: the railroad company furnishes its service at stated hours, the telegraph company furnishes its service not instantly, but in the order in which messages are received for transmission, the telephone subscriber must wait until the connection is completed; whereas, there must be sufficient capacity ready at all times to supply gas, water and electricity, which must be delivered at the very moment the consumer chooses to use it, and as long, and no longer, than he pleases to use it.

Factors Governing Cost of Service.—Accordingly, the central station and distribution system must be of sufficient size to meet the maximum load of the entire system. This is specially true in the matter of electric energy in that there is no practical manner in which any large amount can be stored. It is evident, therefore, that the cost of serving should be governed by factors other than that of the actual energy used by each consumer. There are three recognized factors which should enter into the establishment of rates for service; namely, demand cost, output cost and consumers expense.

Demand cost, is the fixed charges on the cost of that portion of station equipment, transmission lines, transformers or substations, real estate, buildings, etc., used and useful in supplying the maximum requirements of the consumer, also, a certain portion of the general expense, taxes and depreciation. In other words, it may be classed as rental charge for the equipment necessary to take care of the consumers maximum load.

Output cost, is the cost of the energy used by the consumer and consists of the cost of fuel, oil, water, labor and supplies incidental to power-house operation.

Consumers expense, is the cost of reading meters, billing and collection expense, new business expense and consumers premise expense.

Charges Shoud Have Relation to Cost.—In considering a proper compensation for service the charge rendered should, as far as practical, bear relation to the cost of rendering it. If it is a matter of competition it will solve itself, for a utility cannot for long supply classes of consumers at a loss and recoup that loss by exorbitant profits from other classes of consumers.

It is clearly to the advantage of the utility to obtain as its patrons those whom it best pays to serve and to provide such means as are practical to compensate those consumers whose operations and usage are of benefit to the system of the utility. On the other hand, it is equally important to both the utility and its consumers in general that in so far as practical, the utility receive a proper compensation from those consumers whose short hours of operation are such as to necessitate a capacity expense not commensurate with their usage.

Inasmuch as the central station cost is one composed largely of fixed charges and is not materially affected by the quantity of the product sold, the cost of the product delivered to the consumers premises is affected more by the hours use of the maximum demand, or load factor, than by any other factor.

Situation of Fixed Capital Costs.—Prior, therefore, to the establishment or readjustment of rates the utility ascertains the amount of interest and other fixed charges on the property and equipment used and useful in the supplying of service to its patrons. The fixed capital costs thus established are allocated and distributed to the various classes of users on its system, using as a basis for such allocation its experience and records as to what percentage of such costs is chargeable to each particular class. Thus is established the demand cost, previously referred to.

The output cost and customers expense, the remaining factors which enter into the ultimate rate, are established in a like manner, however, these costs unlike the demand cost, though averaged, would not reflect any great difference whether consumers were treated as a class or individually. This procedure is equitable to all concerned, in that proper consideration is given to diversity factor, or the ratio of the sum of the maximum demands of a given group of consumers at different times, to the actual maximum demand by the group at one time, and at this time it may be well to emphasize the fact that the Central Station Industry is dependent for its existence on diversity and demand factors.

Forms of Rates.—There are many forms of rates in use throughout the country, such as: Flat rate (no meter), uniform meter rate (flat rate per unit of measurement), meter rate based on quantity of consumption, meter rate with a minimum charge, meter rate based on hours use of maximum rated capacity and rates varying with time of day at which service is used, etc.

All of such rates are established using as a basis the average operating conditions and average cost of serving a certain class of consumers. In other words, a class of consumers is considered and treated as a whole and the rate per unit of measurement and/or the block of the rate as well as the minimum charge are so constructed as to insure a fair and reasonable return to the utility.

Under such forms of rates the costs of serving, or fixed capital costs, are as a rule included in the first block of the rate. There are advantages and objections to each and all of such forms of rates particularly as pertains to flat rates. The one objection to each and all of such rates is, that the consumer whose operations are helpful to the system, must help carry the consumer whose operations are harmful and in some instances must help carry those who are served at a loss to the utility.

Primary Objectives of Rate Schedule.—A rate schedule should have three primary objectives; First, to secure a satisfactory profit for the utility, second, to develop the sales of the utility's product, by discouraging the use of private plants and other sources of supply, developing new uses for its products and improving the load factor of its system by improving the load factor of its individual consumers. The third objective is to prevent discrimination by providing rates so constructed that each class of consumer, and when practical, each consumer will bear a proper share of central station costs.

Inasmuch as the demand cost, or as it is sometimes termed, readiness to serve cost, is the principal factor in the cost to the utility supplying gas, water and electricity and is not materially affected by an increased consumption, it should be given primary consideration in the establishment of rates for service. That this method of charging for service is practical is evidenced by a review of rate schedules of electric utilities, throughout the country.

At the present time the form of rate which comes the nearest to fulfilling the objectives referred to, is the demand or demand and energy rate.

The Demand and Energy Form of Rate.—This as the name implies, is composed of two separate and distinct charges; namely, a demand charge and an energy charge, and each is essentially as much a part of the ultimate charge for service as the other.

ADVERTISING PAGES REMOVED

To participate in, or benefit by this form of rate, it is necessary that the operations of the consumer be such that his load factor, or hours use of his maximum or billing demand be greater than that of the average consumer, for if otherwise, the cost to him for such service would be less under a form of rate not having the Demand Charge feature.

Establishing the Demand Charge.—There are a number of methods employed throughout the country in determining the demand and in establishing the demand charge under the demand and energy from of rate; some of which are as follows:

Demand as contracted for and limited by a demand limitator.

Demand based on rated capacity of consumers equipment.

Demand based on rated capacity of transformers installed.

Demand based on instantaneous peak indicated by watt-hour meter or recorded by graphic instrument.

Demand based on integrating peak of 5, 10, 15, 30, etc., minutes duration, as shown by installed demand meters.

Demand based on average of two or more of the integrating peaks, referred to.

In analyzing these methods you will note that some would tend to curtail the size of the installation and thus retard further use and development, invite fraud, provide compensation for a demand, that may, but has not yet been demanded.

The intent of the method adopted should be to establish a charge for service in the same manner that it would be determined if the consumer was installing a private plant of the exact size necessary to supply the demand created.

The last two methods; namely, demand based on integrating peaks of certain duration, and the average of such peaks, are the methods more generally employed at the present time.

If the method adopted for the determination of the demand involves the installation of demand meters, or entails added expense to the utility, the demand schedule should be protected by a minimum charge providing a sufficient amount to insure the costs of determining the necessary demand information.

The next angle involved in applying the demand schedule is as to whether the billing demand, once established, shall apply only during the month such demand was created, or shall it continue for twelve months or until exceeded by the demand of a subsequent month.

The Measure or Billing Demand.—The basis of practically all business is annual, rather than monthly, and the manufacturer or merchant fixes the prices of the goods he sells on the basis of his annual overhead charges and costs of doing business and which apply in the good season, as well as in the bad.

In a case before that body the Public Service Commission of Indiana said, "In the operation of Electric Utilities it is also noteworthy that all electrical engineers of recognized ability recommend the kilowatt Demand Charge, which is in reality a Ready to Serve Charge applied to consumers of electric current, based on capacity required.

In the year 1924 this Commission made a very thorough investigation of the Ready to Serve, or Demand Charge applying to electric Utilities, with a view of eliminating it, however, very weighty argument, by those familiar with its application succeeded in convincing the Commission of the fairness of the Demand, or Ready to Serve Charge and that it should not be disturbed."

In another case the same commission defined the measured or billing demand as the greatest average rate of consumption of electric energy used by a consumer for fifteen consecutive minutes within the period of one year.

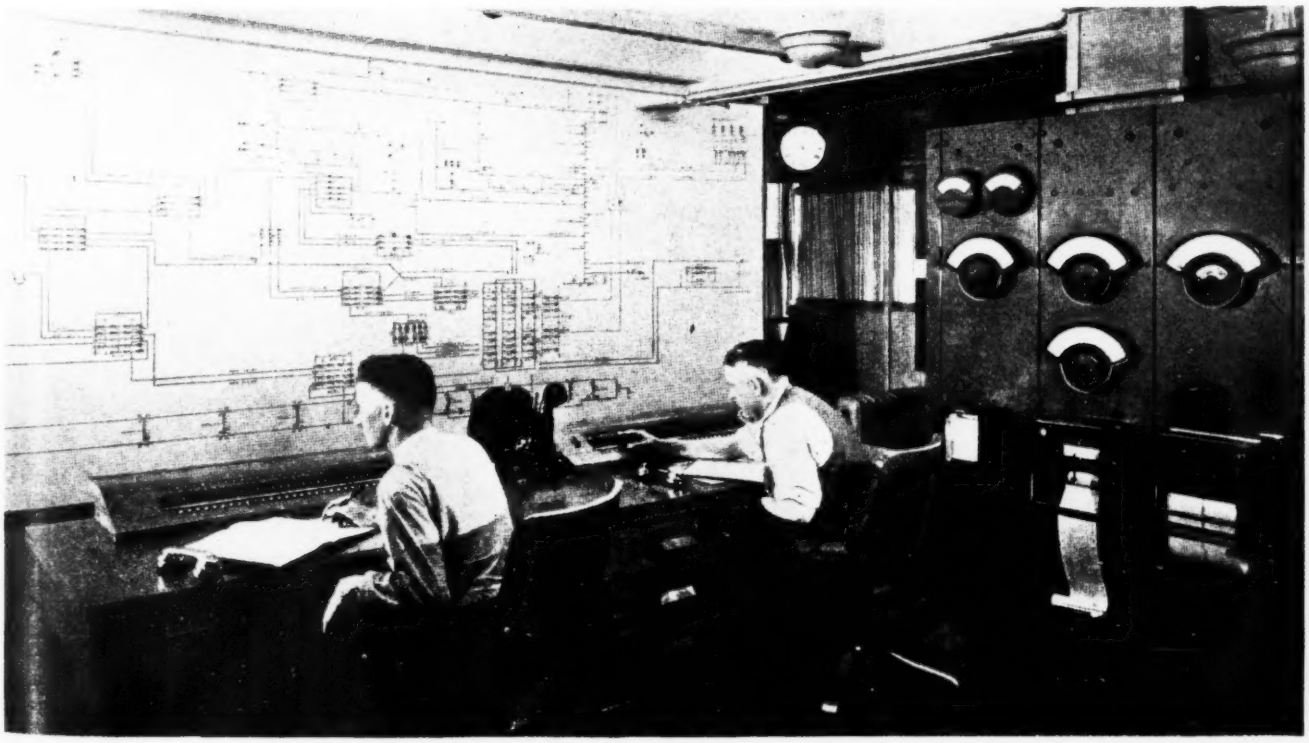
The principle of this demand or ready to serve charge is not only universally recognized as being sound, but it has been repeatedly approved by state public service or utilities commissions throughout this country.

The prime purposes accomplished in the use of the demand and energy form of rate is that it insures a proper compensation for standby, breakdown, or auxiliary service and thus enables the utility to properly compensate the consumer whose load factor reflects to the betterment of the entire system.

In other words, so to speak, the demand and energy form of rate places the consumer on his own feet and ultimate charges are commensurate with his operations.

Typical Example.—The following example and which is typical, emphasizes the fairness of this form of rate:

"A" has connected and in use coincidentally 2-300 H.P. motors loaded



Headquarters of System Load Dispatcher of Hydro Electric Power Plant of City of Los Angeles, Calif.

to capacity and thereby establishing a demand on the company's system of (600 H.P.X .746 KW) 447.6 KW. He uses this demand of 447.6 KW one hour per day, establishing a daily consumption of 447.6 KWH or (447.6 X 360 days) 161,136 KWH per year.

"B" has connected and in use coincidentally 2-50 H.P. motors loaded to capacity and thereby establishing a demand on the company's system of (100 H.P. X .746 KW) 74.6 KW, he uses this demand of 74.6 KW six hours per day establishing a daily consumption of (74.6 X 6 hours) 447.6 KWH or (447.6 KWH X 360 days) 161,136 KWH per year.

Accordingly, "A" has six times the demand of "B," but it is in use but one-sixth the number of hours that "B's" demand is in use.

The total yearly consumption for each is identical, namely, 161,136 KWH per year. The total yearly costs for electric service to each under a block energy rate would be the same, thus providing no incentive for a longer hours use of the demand and no penalty for an abnormal demand.

Under the demand and energy form of rate consumer "M" and "B" would pay the same amount for energy, but in addition each would pay a ready to serve, or demand charge proportionate to the cost to the utility supplying his demand requirements. The demand cost to "A" would be six times as great as the demand cost to "B," and this is as it should be:

In conclusion, follows an abstract from an opinion of the Public Service Commission of Indiana, in a case before that body, *"While there are weeks and months in which many large users of electricity may not consume any current, it would be unjust and unfair to require the Public Utility to be prepared at all times to furnish them such service without applying the Ready to Serve Charge, known as the Kilowatt Demand, based on capacity."*

Acknowledgment.—The foregoing is an abstract of a paper presented at the annual meeting of the Indiana Section, American Water Works Association, at Purdue University, Lafayette, Ind., March 20 and 21.

Unusual Core Wall in Australian Dam

The core wall of Silvan dam No. 1 for the new water supply of the city of Melbourne, Australia, according to the "Commonwealth Engineer," is particularly interesting. The drainage system is built integral with the wall and is of an unusual type, consisting of a series of vertical wells constructed monolithically in the wall itself near the downstream face, communicating with a collecting and inspection gallery near the bottom of the wall, below the natural surface of the ground. The wells are 3 ft. in diameter and are spaced 4 ft. 6 in. on centers along a line 2 ft. 6 in. from the downstream face of the core-wall structure. The inspection gallery below the line of the wells is 2 ft. 9 in. wide and 5 ft. 6¾ in. high, of semi-oval section, with a flat footway and a side drain 9 in. wide and 9 in. deep. Each well communicates with this gallery by a 6-in. galvanized-iron pipe set in the concrete. The gallery drain discharges at its lowest point into the tunnel which carries the outlet pipes from the reservoir. Weepholes, spaced 4 ft. 6 in. on centers along the length of the gallery, are provided for draining from the earth fill on the downstream side of the core wall. Similar weepholes are provided at intervals in each of the drainage wells. Access is obtained to the inspection gallery by means of shafts from two of the wells that are equipped with ladders, near the ends of the dam.

The theory of action of this drainage system is that any cracking of the wall that might occur and might allow leakage will almost certainly break into a well and not pass through the solid concrete between wells to the downstream face of the wall. Periodical inspection of the lower ends of the pipes in the gallery will show whether water is coming into any of the wells. If the amount of water appears at all considerable, the well can be opened by digging down from the crest of the dam and removing the concrete cover with which each well is equipped. A detailed inspection can then be made down the whole depth of the well, and any cracks can be dealt with in an appropriate manner. Should the crack and leakage be serious the well concerned, and possibly those adjacent to it can be filled with concrete, and the wall thus strengthened at this point. Thus, in effect the well system provides a ready means of inspection of the behavior of the whole wall, and of quick access to any part that may be giving trouble. It is believed that this is the first time this system has been used in any part of the world.

The real core wall may be considered as that portion of the structure in front of the line of wells. It is 1 ft. thick at the top and increases in thickness to a point below natural ground surface on batters of 1:60 on both sides. The wall, together with its drainage system, has reinforcement placed 6 in. from both upstream and downstream faces, consisting of meshes of ½-in. mild steel rods spaced at 12-in. centers vertically and horizontally. In constructing the wall it is poured in the usual manner between forms, and the drainage wells are molded by means of cylindrical wooden moving forms which are drawn up by stages as the wall rises.

Extensive use is being made of mechanical appliances in the construction of the dam. An aerial ropeway, 3¼ miles in length, conveys sand and cement from the nearest railway station to the dam. The ropeway carries 100 buckets of 7-cu. ft. capacity, and each bucket travels the length of the line in just under one hour. The system is driven by a 40-hp. electric motor and is capable of moving about 130 tons in eight hours. Stone is quarried about 2 miles upstream from the dam site and brought in on a narrow-gauge railway. Concrete is mixed at the ropeway and railway terminals and transported to the core wall in a 6-ton skip running on a cableway 2,000 ft. in length.

Material for the fill is excavated by steam shovels working at three locations, both upstream and downstream from the dam, and transported by means of narrow-gauge equipment. The fill is spread by tractor-drawn scoops and consolidated by steam rollers. There are four Cletrac and five Caterpillar tractors on the work, and the general practice is for eacn tractor to draw two scoops which pick up the material as it is dumped from the trucks and spread it where desired. By this means the earth fill is spread in layers from 6 to 8 in. deep, and each layer is consolidated by rolling before the next is spread. An Ateco hydraulic dirt-mover has been recently put on the work of spreading, and this promises to be far more efficient than the scoops.

The steam rollers used for consolidating the spread material are 8, 12 and 15 tons in weight, and are equipped with special deeply-grooved rollers. The grooving of the rollers aids the consolidation, not only in giving an even distribution of pressure, but also in leaving a rough surface that provides good binding with the next layer.

Silvan dam No. 1 will contain 1,670,000 cu. yd. of rolled earth fill and 60,000 cu. yd. of concrete.

Ohio Conference on Sewage Treatment

The 4th annual Ohio Conference on Sewage Treatment will be held Oct. 16 and 17 at Dayton, O. The executive committee of this year's conference includes the following: Floyd G. Browne, Marion, chairman; T. C. Schaetzle, Akron, vice chairman; M. W. Tatlock, Dayton, secretary-treasurer; O. F. Schoepfle, Sandusky, member-at-large; F. D. Stewart, Columbus, editor.

The Ohio Conference on Water Purification will be held the same week as that chosen for the sewage conference, as is customary, for the convenience of those desiring to attend both meetings.

Dayton is served by a new sewage treatment plant, which was put into service last fall. This plant will be of interest to all members of the conference, not only because it includes some new and novel features but also because of the excellent landscape treatment of the plant site. Those attending are assured a hearty welcome by the officials of the city.

Relation of Public Utility to Customers

A Practical Discussion of the Many Considerations Entering Into the Everyday Business in the Water Works Field

By JOHN A. BRUHN
Sales Promotion, Indianapolis, Ind.

ONE of the distinctions between public utility business and other kinds of business is the peculiar duty or obligation to serve the entire public attached to the former. A typical statutory direction to public utilities with respect to service reads:

"Every public utility shall furnish, provide, and maintain such service, instrumentalities, equipment, and facilities as shall promote the safety, health, comfort, and convenience of its patrons, employes, and the public, and shall be in all respects adequate, efficient, just, and reasonable."

It is probably true that no other business in the country carries such broad responsibilities.

Sound Business Practice Essential.—The management of a water plant is confronted with the problem of furnishing an abundant supply of purified water for domestic, commercial, and manufacturing purposes. To meet the requirements of each class it is necessary that the supply be free from water-borne disease germs, turbidity, and mineral content injurious to boilers or manufactured products; that the pressures be adequate and continuous; and the quantity available at every point be sufficient for ordinary, as well as fire protection purposes. For each endeavor there is a resulting cost. The business of the water company cannot be successfully conducted except in accordance with economic law and sound business practice.

We find in modern times the public buying many of its necessities without the power of discretion, or refusal being invested in the seller of such supplies; as for instance, water. Going further to the point, the terms and conditions under which such sales take place are largely outlined by the public through Public Service Commissions.

The company with which I'm connected—the Indianapolis Water Company—has for years been taking its task seriously—to furnish an adequate, dependable supply of purified water under satisfactory pressure at a reasonable and equitable cost. We are striving to profit by mistakes made and experience gained and to make as efficient as can be made possible the administration of the public water supply.

Importance of Satisfactory Customer Relations.—Customer relations is important to all business enterprises. It is conceded that honesty and frankness pay and that some effective method must be found to inform customers as to the nature of the services supplied. These efforts must be made by each utility company in the way best suited to the customer and to the mass psychology of the territory which it serves.

People are moved by actions and attitudes, plus facts which appeal to their imaginations and create confidence and belief. Public relations are truly satisfactory only when there is general confidence that the service rendered is all that can reasonably be expected, that the price charged for it gives a reasonable profit, and that the management is constantly alert to effect improvements in service. The purpose of public relations is to establish such confidence. It must be deserved and based on truth, frankness, and good performance.

Employees' Good Will Important.—A public utility needs the good will of its employees before it may have the good will of the public. That statement has been made and agreed with many times. Regular meetings of the employees, together with interest shown by the company in their welfare, tend to improve the attitude of the personnel toward the company and its management. In my comparatively brief association with the company I have been favorably impressed with the importance and value of the educational meetings held by the commercial department. At last month's meeting, attended by more than 50 members, careful consideration was given the subject "Our contact with the public." On one night three members of the department gave well prepared papers on various phases of the subject. "Efficiency in Meter Reading and Billing." On April 18 the evening will be spent on a study of the construction and operation of water meters. A chief contact for making friends with the customers is the company's employees. Careful attention should be given the human element in service. It sarcely needs to be said that the utility company should want all of its employees to be contented, happy, and prosperous for their own benefit, for the company's benefit, and for the public's benefit, as their health of body and mind is reflected in the quality of our service. Knowledge of this was the dominating factor why our company requires a thorough physical examination of all employees and firmly believe in group insurance.

Contacts with Customers.—Major public contacts between utilities and their customers generally develops along the following lines:

1. Applications for service.
2. Meter reading.
3. Commercial activities which include billing, collections, and disconnections.
4. Payment of bills.

A company's policies in regard to the above are obviously worth considerable attention.

In the rendering of public service it seems an unfortunate fact that it is apparently impossible to satisfy everyone, try as we may, because of changing conditions, additions of new personnel and the idiosyncrasies of certain customers. However it is our policy to give every consideration, courtesy and service the customer is entitled to and can reasonably expect.

Classes of Customers.—In our organization the customers are divided into three main classes. We have at the present time about 70,510 domestic accounts, which includes locations where water is used primarily for domestic purposes, approximately 670 industrials consisting of factories, railroads, laundries and places using water for industrial purposes, and 4,233 commercial customers by which term we mean stores, hotels, hospitals and other consumers not found in the two other classifications.

Naturally the amount of business or revenue received from the above cannot be the basis for rendering of service. Domestic customers because of their numbers and the nature of consumption, take up by far the greater part of the commercial department's time.

Signing Up the Customer.—The first impression made by the utility on its customer is at the time the contract is signed and is lasting. Therefore, the personnel of this contacting point should be carefully chosen. Our experience indicates that men with an efficient, courteous, and friendly manner, fill the position best. They need not necessarily be middle aged, but should possess mature judgment, a good education, and training, be self confident, have a good personal appearance and the ability to take a certain amount of abuse without becoming exasperated even when circumstances are trying.

Possibly the first impression is made when the customer calls to secure pre-

Laying 60-In. Water Supply Conduit from Filters to High Service Pumps, Indianapolis Water Co.

liminary information before coming to the office. The telephone operator's importance is frequently underestimated. She, and the phone desk clerks, must, of course, be able to hear well besides having an abundance of patience to deal with an irate customer having real or fancied wrongs, who has made up his mind to secure what he wants, whether right or wrong. It is necessary that the switchboard operator know the particular duties and personnel of various departments. In calling some business houses it is not an uncommon experience to talk to four or five persons before getting the proper one, especially if the call is concerning something a little out of the ordinary even though what was wanted had been clearly stated. Utilities are also frequently guilty of this inefficiency.

Prominence of Personnel.—Commercial activity and personnel are brought into more intimate contact with the public being served, than any other part of a utility working system. Recurrent meter reading, billing, collecting, investigating, etc., which logically are parts of the commercial end of the organization bring into inevitable prominence the part that personnel must play in the success or failure of the business. There is much truth in the statement of one writer who says: "One unwise move on the part of an employee can do more toward upsetting a utility's business routine than the breaking of a part of the physical system. Repair parts are available on a handy shelf. The same cannot be said regarding the sudden replacement of an uncoordinated part of a human mechanism.

We welcome inquiries made in good faith, for through them, and constructive criticisms of our present service, we will be able to render more efficient service in the future. Some time ago we ceased using the word "complaint" and substituted therefor the word "inquiries," it being our experience the majority of the people were desirous of making inquiry rather than registering a complaint. Some, however, are made where there is no apparent reason or cause, purely to get bills reduced whether justified or not.

Office Contacts.—Clerks and cashiers in the office are the chief contacts between customers entering the office, as are meter readers, inspectors, and district turn-on and turn-off men with the far greater number outside. Outstanding qualifications for the field men are a courteous, gentlemanly appearance, neatness and knowledge of his duties. We are trying to inculcate in the minds of these men the idea that they are representatives of the Indianapolis Water Company and not merely meter readers, clerks, or turn-off and turn-on men. They should have at heart the duty of service to the customer, as well as faithfully serving his employer.

Handling Delinquent Accounts.—In the matter of delinquent accounts and disconnections much can be said. Broad applications of hard and fast rules may react to the disadvantage of the utility both from the standpoint of relations and financial return. When a customer's service is disconnected there is no income, although the investment in equipment remains the same.

Collections are important, but shutting off a concern's service during financial stress may result in closing of the plant or receivership and bankruptcy along with the laying off of several hundred men who are then not able to pay their water bill. Drastic action on the part of the utility may result in unfavorable criticism from the stockholders and directors of the firm. It is oftentimes wise to get a true picture of the situation from banks, creditors, stockholders or directors of the company. Special reports from organized credit associations are valuable. Consideration must be given to the nature of the enterprise, its prospects, organization and management. The fact that the utility has given assistance to a firm in time of reverses cannot help but result in a friendly feeling on the part of the concern in question. Delinquent residential accounts are divided into three main classes. (1) Those inveterates who never pay until they are threatened with being turned off. (2) Those who are able to pay but through careless or indifference neglect to do so. (3) The ones who generally pay their bills promptly but who occasionally, on account of sickness or unemployment, are in a straitened circumstance for a short time.

For habitual delinquents a firm stand should be taken. They will have more respect for a utility if it follows its collections promptly.

The people of the second class are probably the hardest to deal with. They consider it a personal insult if service is denied them and insist their credit is good; that the utility need not worry if their bill goes unpaid for months. A personal interview or letter in their case is best, with an explanation why it is necessary to treat all consumers alike. However, the expense incident to this is almost prohibitive.

Extending Time on Delinquent Accounts.—The third class requires a great deal of sympathetic interest and attention on the part of the collection department. Those with a good credit standing of some duration should be given special consideration. Here is a good opportunity to create a friendly feeling for the company.

No hard and fast rules can be applied to the extending of time on delinquent accounts, and it must be left to the discretion and judgment of the head of the collection department. With this part of the commercial department lies the opportunity to increase favorable public relations. The customer owes it to his fellows to make prompt payment of bills so that the cost of collection may be held at a minimum. A heavy collection cost places an undue burden on all patrons of the company, the majority of whom are prompt in their payments.

Utilities in general, I believe, are beginning to realize that the introduction of a third party or guarantor is not conducive to good public relations. The securing of a deposit limits the

parties concerned to the customer and the company.

The hearty co-operation of all utility employees in the rendering of a courteous efficient service will so favorably affect public opinion that the resulting good will and friendly feeling will be a valuable asset.

High grade efficiency can scarcely be obtained through short term employees either in minor or supervisory positions. In our company the average service of regular employees is 10 years, and of the eleven department heads 34 years.

There are some persons so constituted that it is very hard for them to be fair or pleased with the best of service, but on the whole American men and women in the mass, are honest, shrewd, and fair, and will act just when satisfied they are being treated equitably and efficiently.

Making Adjustments.—As a general rule it is a poor policy to make adjustments because a service of value has been rendered at a cost and if this is not paid by the original customer it must be borne by other patrons who were in no way responsible for the excess consumption. Our duty is to serve the public. If special consideration is shown one man the same should be given all under the same circumstances. Discrimination in service and rates cannot be legally carried out. Some advocate special dispensations on rates for hospitals, religious enterprises, and educational institutions. The trend today is against this. There is no such thing as free water, any discrimination here must be borne by all customers.

Special Investigations.—The matter of just how far we can go in the furnishing of service to individuals at the expense of the public as a whole is a mooted question. Last December our meter readers made 552 special investigations to determine the causes of excess consumption. The average number made for each month of the year 1929 was 400. Reports were made on these. Each time a particular individual service is given operating expenses are naturally increased. This is excellent work but it also brings up the question how far in this we can go for the additional expense is carried by all.

Fairly definite rulings have been made as to the extension of mains, services, disconnections, flushing of mains, and the shutting off of sections while repairs are being made.

Customer's Part of Relationship.—Now concerning the customer's part in the relationship or interdependence between him and his utility. When a customer wilfully wastes unmetered water or makes surreptitious use of the service all of us know that instead of beating the water company he is ultimately raising the cost of service to other users, possibly including himself in future years. This holds good for water bills left unpaid as well. Likewise the person making unreasonable, unnecessary demands, consideration, or the laying of unproductive lines, places an unfair burden on the company and its other patrons. The non-modern property owner passes his share of the upkeep of the water works on to others because he does not comply with reasonable health rules by utilizing the city main in the street. The same principle applies to large industrial fire hazards. Insurance companies are but collectors and distributors and when there is a large economic loss through fire the cost is divided among premium payers. The attitude of mind so prevalent, which advocates the idea that as long as the insurance company pays—why worry, is certainly unthinkable from an intelligent standpoint.

The customer must be reasonable in his requests and remember that there are many thousands of other consumers who have the same right to ask what he does.

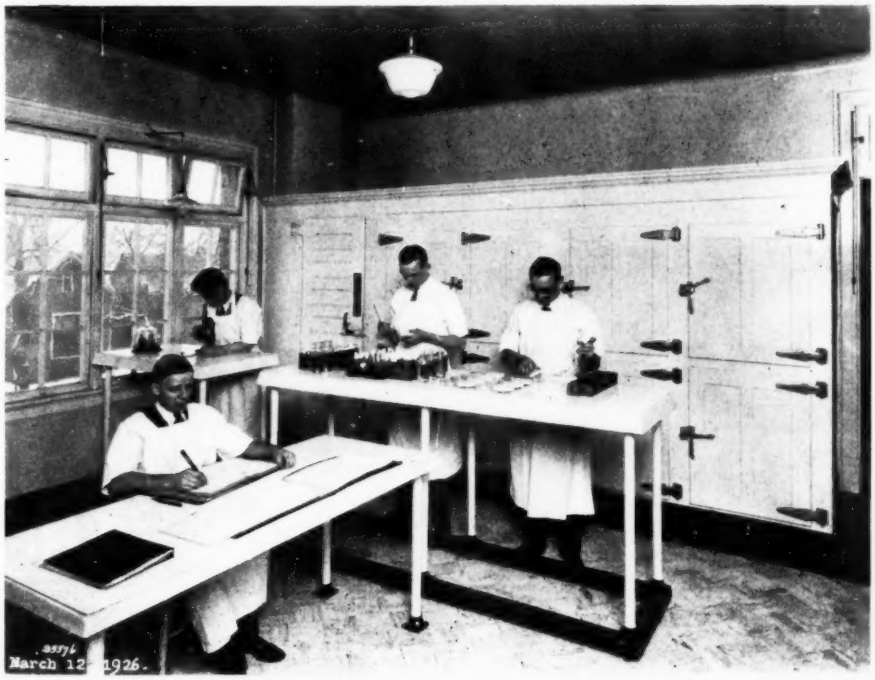
Our company has uniformed its meter readers for the benefit of its patrons and the company, and yet it is difficult for the men to keep themselves looking presentable because of the condition of basements and property in which they must go.

If the consumer is to expect the best of service at the lowest cost, he should remember that he can help materially by promptly paying bills, making arrangements for reading of meter if not home and by not expecting discrimination from the water company in the matter of adjustments, rates or services.

Assertions have often been made that utilities, and particularly water companies, are non-competitive. This may be true in one sense of the word; in others it is not exactly true. In Indianapolis the competition from private sources is very strong, especially among larger consumers, even though according to our rate scale most of them pay 6 ct. per hundred cubic feet. We estimate that more than one-quarter of the water used here comes from private supplies. Over 50 per cent of our pumpage of 34,000,000 gal. per day is sold to industries and commercial houses, therefore, our great dependence on them for business. The water company is called upon to furnish an adequate water supply for industrial and commercial enterprises and in all fairness they should pay their share of the cost of the public water supply service.

In its relations with its consumers and the public, the public utility corporation must deal with thousands of customers coming from all classes and in many cases its necessary rules and regulations will not meet individual wishes of some factory owner, store operator, or householder. Nevertheless it is perfectly possible for the utility to shape its policies and practices so that it may have and hold the good opinion of the very large majority of the public.

In an article I read some time ago, a writer expressed the opinion that public utility executives should sit behind the desk less and stand on the platform or at the luncheon table oftener. The more executives mix with people, the more contacts they will have and will become known as human beings just like other people. Good public relations do not depend on overstating the virtues of a corporation, but on calling attention to good work done.



Safeguarding the Water Supply—Bacteriological Laboratories, Indianapolis Water Co.

The idea that public utilities, as well as other large businesses are automatic, mechanical, cold, abstract organizations, driven by an arbitrary and remote power, has long been prevalent. This impression, along with attendant criticism of the utility, and other large business concerns, probably in several instances has not been without foundation.

The policy of some has doubtless been cold, automatic, and unthinking. Impersonal, indifferent treatment given customers results in advantage to no one.

Through experiment and systematizing in a personal rather than an impersonal way and in the application of human rather than mechanical principles toward the solution of problems, an organization can be developed which, though imperfect as human machinery must of necessity be, have certain advantages unattainable by more inflexible methods.

Many trivial complaints or inquiries will always be received but they should be given courteous, helpful consideration, for usually in the mind of the person who originates the inquiry it is entirely justifiable. Small accounts mean much to people of meagre means. A part of the cost attributed to time consumed by these many small inquiries might be allocated to good-will, that intangible item which is allowed a place as an asset on the balance sheet of private business—why not then on the balance sheet of public enterprises.

The law imposes on us the duty of furnishing a dependable, adequate purified water supply under satisfactory pressure at fair and reasonable rates. It should be our ambition to do more than that. Some have said that no acceptable work can be done in this world without a certain infusion of idealism. And we are not ashamed to admit that we have ideals, and try to convert them into accomplishments.

Acknowledgment.—The foregoing is an abstract of a paper presented March 20 before the Indiana Section of the American Water Works Association.

Adequate Financial Records Important

The following interesting discussion of the value to the water works operator of complete information on costs was given by W. C. Hail, Senior Public Accountant, The League of Kansas Municipalities, in a paper presented Feb. 13 at the Kansas Water Works School:

"Water is as free as air," is an expression frequently heard during an early period of municipal water plant operation when a general change from the old flat rate to the present meter system of selling water was taking place.

It was not an uncommon occurrence for prominent and successful business men, whose opinions were respected, to endorse the old wholly impractical and wasteful method of selling water on a flat rate basis. Why? Because a city's water supply was then considered as having little or no commercial value.

Increasing general property tax levies and bond issues for the support of our municipally owned water plants were perhaps the main factors in bringing about a change in public opinion regarding the commercial value of a city's water service.

A number of years ago a well known plant superintendent, in reporting to the city governing body on the subject of inadequate water rates, said in part —"It has been a matter of common knowledge for years to all who have been familiar with the water department affairs that the rates under which we are operating are not sufficient for the needs of the department. All of the water is now sold at less than cost and some classes of consumers are paying considerably less than cost. This can only be done, of course, by meeting the deficit by general taxation. At present we are levying taxes and paying the interest and sinking fund charges on water works bonds, and in many cases making repairs from bond issues. Thus carrying a proportion of the repair cost into the general tax levy."

No one believes that deficits of privately owned public utilities should be met by general taxation, and the same reasoning holds good for municipally owned public utilities.

It is now a recognized fact that fundamentally the purification, distribution, and sale of water are important commercial undertakings and the water plant operators in every community, regardless of its size, are or should be impressed with the importance and value of keeping adequate and accurate records of the production and plant operating costs. The information made available through the operator's records, if complete, is of the utmost importance in determining the cost of furnishing water. It is a comparatively simple matter to determine the cost of producing and maintaining any commodity if quantity production is established and adequate cost recorded through a master meter. Such a meter should be standard equipment with every water plant operator.

In this discussion it should be understood that the general suggestions pertaining to plant operators' records are considered as supplemental records to be used by the chief accountant to tie in with other major items of expense in supplying city water, such as general expense, distribution and line costs, repairs and replacement expense, interest and amortization of outstanding indebtedness.

The quantity of water pumped into the mains daily may be readily and accurately recorded through a master meter. Such a meter should be standard equipment with every water plant operator.

The unit cost requirements will of course vary in different communities according to the methods employed in producing water, but as a general rule the operator is concerned with the cost of plant operation and maintenance. A simple and practical plan of recording such costs is by means of a monthly inventory report showing the quantity and cost of fuel oil, lubricants, gaskets, waste, packing, tools, engine repairs, and all other plant operating costs.

A definite and accurate record of the total cost of plant operation and quantity of water pumped is very essential and the most important factor in establishing a rate making basis and in determining the financial showing made by the water department each year.

Who's Who in Engineering

The American Engineering Council announces the appointment of a committee to co-operate in the publishing of a new edition of "Who's Who in Engineering." The function of the committee, according to Lawrence W. Wallace, executive secretary of the council, is "to provide such advice on the qualifications of engineers as will enable the publishers to issue a work which shall be authoritative."

The members of the committee are:

R. F. Schuchardt, chief electrical engineer, Commonwealth Edison Company, Chicago; John S. Conway, Washington; Dr. Harry A. Curtis, Department of Chemical Engineering, Yale University; C. R. Dooley, Standard Oil Company, New York City; Colonel Frank M. Gunby, associate, Charles T. Main, Inc., Boston; Arthur Huntington, Iowa Railway and Light Corporation, Cedar Rapids, Ia.; B. A. Parks, Byron E. Parks & Son, Grand Rapids, Mich.; Dr. H. S. Person, managing director, Taylor Society, New York City; Dean A. A. Potter, School of Engineering, Purdue University, Lafayette, Ind.; George S. Rice, chief mining engineer, U. S. Bureau of Mines, Washington; F. F. Sharpless, consulting engineer, New York City; Robert Sibley, executive manager, California Alumni Association, University of California; Major Brehon B. Somervell, district engineer, U. S. Engineer Corps, Washington.

The committee represents membership in the following societies:

American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Agricultural Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, Grand Rapids Engineers' Club, Society of American Military Engineers, Society of Industrial Engineers, Taylor Society.

Iron Removal at La Porte, Ind.

Operating Results and Costs at Water Purification Plant

By C. C. FOUTZ
Superintendent Water Works, La Porte, Ind.

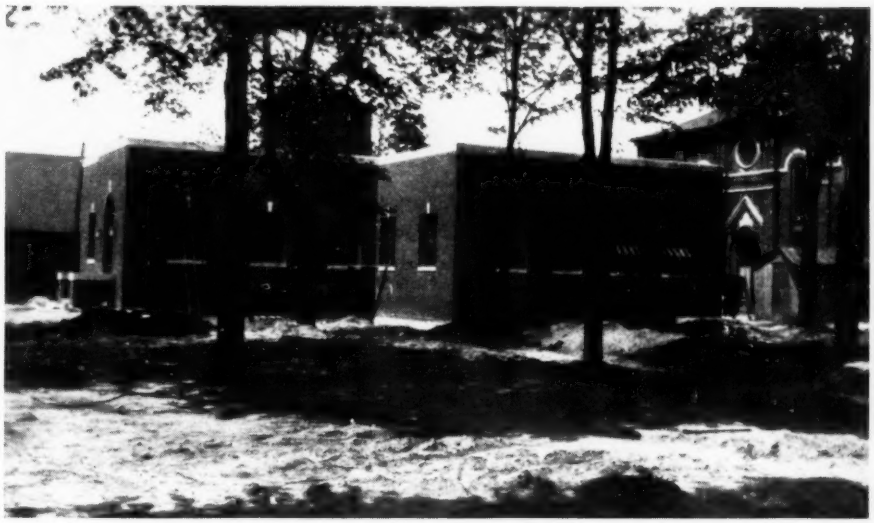
THE iron removal and purification plant at La Porte includes an aerating device consisting of 64 "Sacramento" type nozzles, discharging above a concrete "splash tray." The water flows to the center, whence it drops through a duct, nearly to the bottom of the aeration basin, which is a concrete reservoir 60 ft. in diameter and 20 ft. deep. The water rises in a diverging flow to a metal wier and conductor built around the basin and leveled to assure an equal flow at all points.

The effluent of this conductor goes to a mixing chamber, containing 5 horizontal passes, and 30 vertical baffles, and which discharges into the settling basin, which is a concrete reservoir 100 ft. in diameter and 24 ft. deep, with a baffle wall extending nearly across in a center line, so that water passes nearly around the circumference to a 24 in. cast iron pipe leading to the filters.

From the filters water passes to underground storage reservoirs from which suction pipes emerge.

The two concrete reservoirs referred to as the aeration basin and settling basin were formerly used as storage reservoirs and their cost is not included in the iron removal plant beyond the work required to convert them to the uses of iron removal.

The "raw" water supply is pumped from low duty station, 4½ miles from the city, directly through the aeration nozzles. The water flows by gravity from that point to filtered water reservoir.



Another View of the LaPorte Water Purification Plant

The "Sacramento" type nozzles have been very satisfactory, have been closed down and started and operated at 2 M.G.D. to 6 M.G.D rate and from 90 degrees above to 22 degrees below zero, with no difficulty. Considerable interest has been shown by engineers in regard to their performance.

Alum is introduced at center of aeration basin at the rate of approximately 80 lb. to each million gallons. This produces a good floc and seems to give best results. This alum is fed through a "Gaunt" dry feeder and carried in solution through a hose to the point of use by means of a steam ejector.

The detention periods are: in aeration basin, 7 hours; in settling basin, 19 hours. This is based on normal operation of 4 M.G.D. The total capacity of aeration basin is 1,200,000 gal., settling basin is 3,140,000 gal. while the filtered water storage is 1,500,000 gal.

Iron Content of Water.—The water coming to aerators varies greatly in iron content, and may be anywhere from 1.3 to 15 P.P.M. A typical colorimetric test for iron at the main points of operation is given.

	Unfiltered Samples P.P.M.	Filtered Samples P.P.M. (Filter paper used)
Raw water	6	3
Aerated water	4	1
Settled water	2	.6
Filtered water	.2	.2

This table indicates the proportion of iron removed by each operation. Filtered water shows .0 to .2 P.P.M. in daily test.

The Filter.—Four rapid sand filters are used, of 1 M.G.D. normal capacity. Each filter bed consists of 18 in. gravel in 5 grades and 36 in. of silica sand. The filters are equipped with rate of flow, and loss of head gauge, rate controllers and hydraulic operated valves.

The filters are operated as near full capacity as possible, average run on full load is 55 filter hours. The beds wash freely and an average wash of 5 minutes at 4,000 gal. per minute, a total of 20,000 gal. per wash, cleans them in good shape. We have no filter problem as the water is free from mud, silt, micro-organisms or growths, and only the iron is removed.

The Iron Removal and Water Purification Plant of LaPorte, Ind.

The Nozzles Discharging Above the Concrete "Splash Tray"

Wash water is supplied by a 40,000 gal. elevated tank, which is filled from distributing mains through a 4 in. service line.

Costs.—The cost of the iron removal plant, with connection to old pumping station are:

General contract	$123,695.92
Engineering and supervisor	10,852.71
Contingent costs	2,203.54
Total	$136,752.17

or $34,175.53 per M.G.D. capacity.

The operating cost for 5 months ending Jan. 31, 1929, were:

Operating labor	$ 701.40
Material and supplies	813.07
Interest and depreciation	2,647.45
Proportion of general expense	460.00
Wash water (filtered)	115.41
Wash water (unfiltered)	56.00
Total	$4,835.55

360,016,000 gal. were treated—.01343 per M. gal.

No full time labor is charged to iron removal, the duties of operation being distributed with steam pumping labor.

In comparing operating or production costs it should be remembered that these works are municipally owned, pay no taxes, or dividends and only interest on bonds issued for this purpose is considered, all of which would of necessity appear in a private or corporate owned property. The general expense is also very low, as office and other expenses are divided with other city departments.

Analysis.—The following analysis by the Department of Chemistry, Indiana State Board of Health, and taken from reports by Mr. L. S. Finch, Chief Engineer of the Board follows:

	March 1, 1929 P.P.M.	Feb. 19, 1930 P.P.M.
Odor	0	0
Color	.15	0
Sediment	Slight	0
Turpidity	25	0
Nitrite	.005	.001
Nitrate	0.0	0
Total iron	1.3	.2
Chlorides	6	8
Alkilinity	220	230
Total hardness	314	242

Bacteriological data is same on both samples and reported as satisfactory. This indicates the removal of color, sediment, turpidity, reduction of nitrite, reduction of iron to a harmless point and a reduction of total hardness.

Results of Iron Removal.—The distributing mains and service pipes were extremely foul with iron deposits. Results began to appear immediately on starting the removal plant and the pipes cleared much more rapidly than anticipated and are now practically free from iron deposits, with the exception of valves and dead ends, which infrequently let loose small amounts of iron sludge, which appear locally for very short periods. The "Red Water" nuisance has, however, been overcome and the reaction of the consumers has been all that could be asked for. Even the "Doubting Thomases," of which we, of course, have our share, now admit the success of the operation.

The engineers for this work were Hoad-Decker-Shoecraft & Drury of Ann Arbor, Mich. The plant was designed under the supervision of R. L. McNamee, Principal Assistant Engineer, and Ralph Ehler, Staff Engineer of the same firm was resident engineer and inspector on the construction.

Acknowledgment.—The foregoing is an abstract of a paper presented March 21 before the Indiana Section of the American Water Works Association.

Weed Control on Reservoir Margins

According to the report of the Board of Water and Power Commissioners of Los Angeles, Calif., for the fiscal year ended June 30, 1929, all reservoirs in the San Fernando Valley District are now under complete weed control. To accomplish this, 300,000 gal. of fuel oil were used during the last fiscal year. This oil was applied as a mixture of one-third oil and two-thirds water, and was sprayed under pressure on all weed growths which made themselves evident above the high-water line of the reservoir and over the reservoir bottoms as the water receded. This treatment has been in effect two years now, and resulted in getting a 98 per cent kill of all weed growths, tulles and willows. This method has resulted in material savings from a maintenance standpoint, in connection with the sanitary control on the margin of these lakes, as well as giving the property a neat and pleasing appearance.

Water Resources of North Dakota

Better and more abundant water for the farms, ranches, villages, and cities of North Dakota is a possibility presented in a report just issued by the United States Department of the Interior under the title, "The geology and groundwater resources of North Dakota." Howard E. Simpson is the author. The study was made by the United States Geological Survey in cooperation with the North Dakota Geological Survey.

This report also contains a discussion of the chemical character of the water, by Harry B. Riffenburg. It is published as Geological Survey Water-Supply Paper 598 and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, for 50 ct. It sets forth in detail the results of an investigation covering a period of several years. The topography, climate, geology, and water supply of the state in general and of each of the counties are considered. The object of the investigation was to furnish to each community information showing the best ground-water supply available, whether artesian water can be found in that locality, at what depths water may be reached, through what formations the drill must pass, and what mineral compounds the water is likely to contain. The general availability and usefulness of the supplies are compared as to cost, purity, and permanence wherever the available data permit.

The book contains a map showing the several artesian areas in which flowing wells may be obtained, analyses of 196 typical waters representing the best supplies in every county of the state, and a table of the public water systems of cities and villages that have waterworks. The general descriptions of the rock formations and detailed discussions of the conditions governing the occurrence of ground water in each of the 53 counties are given. Because of the importance of the 7,000 flowing wells to the farming interests in this agricultural state, especial attention is given to the program for the conservation of artesian waters now being carried out under state legislation, a form of conservation in which North Dakota is doing pioneer work.

Water Works and Sewerage

Published Monthly by
GILLETTE PUBLISHING COMPANY, 221 EAST 20TH ST., CHICAGO
Publishers of

Roads and Streets
Engineering and Contracting
Water Works and Sewerage
Motive Power
Tiles and Tile Work
Motor Freight
Road and Street Catalog and Data Book
Water Works Catalog and Data Book

HALBERT P. GILLETTE.....President and Editor
E. S. GILLETTE.....Vice-Pres. and Secretary
E. B. HOWE.....Vice-President
E. C. KELLY.....Vice-President
T. F. KILROE.....Vice-President
J. M. ANGELL, JR.....Eastern Manager
C. T. MURRAY.....Managing Editor
VICTOR J. BROWN.....Associate Editor
CHARLES M. NELSON.....Associate Editor
J. R. BAYLIS.....Associate Editor
J. R. DOWNES.....Associate Editor
L. H. ENSLOW.....Associate Editor
H. J. CONWAY.....Make-Up Editor
L. R. VICKERS.....Distributor News Editor

Cleveland Office.....953 Leader Bldg.
New York Office.....420 Lexington Ave.
San Francisco Office.....703 Market St.

Subscription Price $2.00 Foreign Postage 65c Extra

Copyright, 1930, by Gillette Publishing Company

Misnamed "Ethical Codes"

Several of the professions have adopted "ethical codes" in which minimum fees are specified. If a labor union adopts a rule as to minimum wages, it is not called an ethical rule, nor is there any more justification for regarding a doctor's or an architect's charges for services an ethical matter. It is economics pure and simple. Then why the camouflage? Well, perhaps because it is camouflage, but perhaps because consideration has not been given to the meanings of the words ethics and economics.

At the 1928 convention of the American Medical Association the delegates voted in favor of the following insertion in the ethical code: "The practice of medicine is not the proper function of corporations, and the American Medical Association should use its utmost endeavors to stop this growing abuse." Corporations are usually not ethical organizations. Medical associations never are; their prime functions are educational and economic. They undertake to enlighten their members and to make the practice of medicine more profitable. These two functions are quite distinct, and neither of them is ethical.

If medical corporations give service that is at least equal to that given by doctors in private practice, and charge less for the service, they will survive and multiply, for that has been the history of corporations in other fields. No appeal to ethical principles will prevail, for it is not an ethical matter.

From immemorial time advertising by doctors has been denounced as unethical. Just when does any practice become unethical? When and only when it injures a fellow being. False statements in an advertisement are clearly unethical; true statements are not unethical. Hence to brand all medical advertising as being unethical is a lie, and since broadcast lies are invariably injurious to some one, the prohibition of all medical advertising is itself an unethical practice.

Suppose that a highly successful surgical specialist were to publish his actual hospital record, and contrast it with the average record of all surgeons operating in the same hospital on similar cases; would that be unethical? Yes, according to the code of medical "ethics." No, according to any real code of ethics. Would such an advertisement injure his fellow men? Quite the contrary, for it would guide some of them to a surgeon more skilled than the average. And were he the possessor of the best record over a long term of years, it would serve admirably in showing to the public the most trustworthy specialist in a given class of surgery in their city.

However, were such advertising countenanced by the medical profession, it would speedily result in eliminating a large number of practitioners entirely, and this, we suspect, is one of the reasons why the medical "code of ethics" forbids advertising. The medical and surgical "dubs" far outnumber the really skilled members of the profession, and may be counted upon to vote down any resolution favoring medical advertising even where the advertisements are true.

The Alleged Superiority of Art Over Science

A year or so after Columbus discovered America, work was begun upon one of the greatest masterpieces in the realm of art, The Last Supper, by Leonardo da Vinci. Powers says: "The fact which it is important to bear in mind throughout our inquiry is that Leonardo was not primarily an artist, but a scientist. That was his own judgment, and one which inquiry confirms. * * * Leonardo regarded himself as an engineer, and the chief activities of his life were in this field. His attention was devoted largely to hydraulics, in connection with great projects of his various patrons. * * * He was scarcely less active, however, in military engineering, though a hater of war, while he ventured even into such untried fields as electricity and aeronautics. * * * His inventions include such familiar devices as the wheelbarrow and the camera obscura, the preliminary to modern photography. * * * That Leonardo is remembered not as a scientist but as an artist, is in accordance with a seemingly universal rule. Whenever an individual, a community, or a people, has achieved distinction in war, in government, in science, or in commerce, one or more, and at the same time in art, posterity has remembered the art and forgotten or minimized the other achievements. Athens was the greatest commercial power of the ancient world, but we remember only Homer and Plato and Phidias. Goethe thought that he would be chiefly remembered for his contribution to the science of optics, but the world forgets that he ever concerned himself with science. The value of science to humanity is incalculable, but it is significant that in longer perspective, where values are more justly estimated, it is art that the world delights to honor. The theft of Leonardo's (scientific) notebooks would scarce have won headlines in a paper, but the loss of the Mona Lisa startles and grieves the world."

Thus we are supposed to infer that art will always take precedence over science, that Archimedes must ever

bow to Homer. There is, however, a little matter that Powers and other writers on art overlook. Art was fully matured when Athens was in her glory. Physical science was born with Archimedes, and then was wrapped in swaddling clothes from which it did not emerge for seventeen centuries. Indeed Leonardo da Vinci was one of the very first to unwrap that infant and hold it up to public scrutiny. So we need not wonder that he was prouder of his camera obscura than of his Mona Lisa. It is a far-fetched logic, however, that deduces from such facts the conclusion that art is superior to science.

If, as Powers concedes, Leonardo's camera obscura was father to the photographic camera, it was grandfather to the moving picture, and therefore to the latest of arts. It needed only another scientist, Edison, to invent a sound recording device to enable dramatic art to step from the stage to the screen, and delight the world. Will such science be forgotten by posterity? Will they rank Goethe the poet above Edison the inventor? We doubt it.

Although science existed before the birth of Christ, it was as an embryo, and the vast majority of its conquests are less than a century old. How can one be so sure that when twenty more centuries shall have elapsed only the names of poets, artists, sculptors and dramatists will have survived the erosive effects of time? He is a bold prophet who foretells such an outcome, a very bold prophet and a very bad logician.

A Cure for Our Worst Economic Disease

Economic analyses made by the editor disclose that American per capita productivity is fivefold what it was a century ago. The buying power of the average wages has increased at the same rate as per capita productivity. Not only does this latter fact prove that socialists have been wrong in forecasting dire results from a continuation of the capitalistic system, but that labor unionists have been equally mistaken in their predictions that "the machine age" would enslave the worker and reduce his income.

By socialists and labor unionists alike one important fact has been overlooked. They failed to see that competition among employers would result in average "real wages" rising as fast as the average productivity of workers increased. Yet the U. S. census since 1859 has shown that manufacturing wages have been an almost constant percentage of the wholesale value of manufactured products. The same holds true as to the cost of raw materials used in manufacturing. The clear inference from these two facts is that profits have been almost a constant percentage of the value of manufactured goods.

Recently there has been a loud renewal of the century-old cry of fear that machinery is destined to deprive most workmen of jobs. The "robot" is pictured as a mechanical man who all but thinks; so it is prophesied that even the most skilled of workmen are doomed to be displaced by machinery. While it is true that ever since men entered "the machine age," about 150 years ago, machinery has displaced workmen here and there, it is equally true that machinery has coincidentally broadened the market for goods and has given to the average American an income sufficiently great to enable Americans to buy the increased output. Although this is usually admitted even by the pessimists, they are now arguing that the end of such an adjustment of production and income is in sight. Here again they fail to see that human desires are insatiable, and that so long as any desires remain unsatisfied production will continue to increase.

The great economic problem that lies before business men is to distinguish between those goods and services for which the demand is limited and those for which it is either unlimited or at least very flexible. Four pounds of food daily is all that the average human stomach can digest. Hence, so far as quantity of food is concerned, the demand for food in America can not increase faster than the population, or at the rate of about 1.5 per cent annually. On the other hand, there is an almost limitless demand for more expensive household furniture. We venture to say that few men or women go through the Huntington Art Gallery at San Marino, Calif., and view the magnificent tapestries, rugs, paintings and furniture, without wishing that they were the owners of at least some of it. In that wish lies the latent demand for better household furniture. By advertising and by "furniture shows" this latent demand is being slowly fanned into a great actual demand. No one can say what the result will be eventually, except that it will lead to the spending annually of many times as many dollars per capita for furniture as are now spent. It will require men and machines to make the furniture, and more men and machines to make the machines that make the furniture, and many men to sell both machines and furniture.

There is a limitless demand for amusement, as three industries have proved to the limit, namely, the motor car, the radio and the moving picture industries.

Even yet the motor car is primarily a pleasure giving device. Follow for a moment the result of its evolution. When the gasoline car began to appear frequently on our roads and streets in 1895, who would have dreamed that practically every American family would own one within 35 years? Even now how many of us seriously expect that the average American family will own two motor cars within the next 20 years?

A by-product of the motor car industry has been another industry in which more than two billion dollars are annually expended, namely, the great highway industry. Still another great by-product industry is the one devoted to the production and distribution of gasoline. Had it not been for the motor car, the building and maintenance of highways in America would still be a relatively small industry.

If more business men will learn to avoid trying to expand productivity in fields where latent demand is limited and where the production facilities are already more than adequate, and will direct their attention to fields where latent demand is great, we shall hear less and less of overproduction and the ills of the machine age.

H. P. Gillette

The St. Louis Convention of A. W. W. A.

ARRANGEMENTS are well advanced for the 50th annual convention of the American Water Works Association, which will be held June 2-6 at St. Louis, Mo. The preliminary program of the convention already has been announced. This program, which is subject to revision, is as follows:

MONDAY, JUNE 2, TO FRIDAY, JUNE 6, 1930
Hotel Jefferson, Headquarters

MONDAY FORENOON

8:00 Registration.
11:00 Governing Board.

MONDAY AFTERNOON

2:00 Plant Management and Operation Division and Superintendents' Round Table Discussion.
A. U. Sanderson, Chairman, Asst. Mech. and Elec. Engr., Department of Works, City Hall, Toronto, Ont., Canada.

2:00 Committee on Standard Methods of Water Analysis.
Jack J. Hinman, Jr., Chairman, Associate Professor of Sanitation, University of Iowa, Iowa City, Ia. Everybody welcome.

EVENING

9:00 Informal Reception and Dance.

TUESDAY FORENOON
Main Session

9:00 Opening of Convention.
Jack J. Hinman, Jr., President.
Announcement of Officers elected for the year 1930-31.
Reports of Secretary, Treasurer and Governing Board.
Action on Budget.
New Business.

TUESDAY FORENOON
Main Session (Continued)

Review of 50 Years Growth of the A. W. W. A.
Illustrated by Lantern Slides.
An outline of the growth of the Association and conspicuous water works developments during the past 50 years. Pictures of early past presidents will be shown.
Jack J. Hinman, Jr., President of A. W. W. A.

The Development of Railway Water Supply Practice.
Including an outline of the part played therein by the American Railway Engineering Association and the Boiler Feed Water Studies Committee, and touching upon points of common interest to railway and water utility officials.
C. R. Knowles, Superintendent Water Service, Illinois Central R. R., 6627 Woodlawn Ave., Chicago, Ill. Discussion led by J. B. Wesley, Engineer Water Service, Missouri Pacific Railroad Co., 1310 Missouri Pacific Bldg., St. Louis, Mo.; C. H. Koyl, Engineer Water Service, Chicago, Milwaukee, St. Paul & Pacific R. R. Co., 898 Union Station, Chicago, Ill.

TUESDAY AFTERNOON
Main Session

2:00 Recent Progress in the Art of Water Treatment.
Aiming to make available to the water works practitioner unfamiliar with technical details of water treatment, the important advances in recent years, that their benefits may be more widely applied.
Abel Wolman, Chief Engineer, Maryland State Department of Health, 2411 N. Charles St., Baltimore, Md. Discussion led by W. W. Brush, Chief Engineer, Department of Water Supply, Gas and Electricity, Municipal Bldg., New York, N. Y.; MacHarvey McCrady, Chief of Laboratories, Quebec Provincial Bureau of Health, 59 Notre Dame, East, Montreal, Que.

The purification of Highly Turbid Waters.
Including discussion of modern methods of preliminary treatment and operating experiences and with particular mention of the new Howard Bend Works at St. Louis.
John D. Fleming, Assistant Chemical Engineer, Water Division, 34 E. Grand Ave., St. Louis, Mo. Discussion led by L. B. Mangun, Chemist in Charge of Water Purification, Kansas City, Kans.; F. C. Duncan, Director, Bureau of Sanitary Engineering, Kentucky State Board of Health, 532 W. Main St., Louisville, Ky.; Dr. George F. Gilkison, Superintendent Filtration, Water Department, 5256 Brookwood Road, Kansas City, Mo.

TUESDAY AFTERNOON
Main Session (Continued)

Recent Water Borne Disease Outbreaks and Their Significance.
A recital of such occurrences pointing to the conclusion that unanticipated or unguarded sources of pollution are still common enough to make this problem highly important.
Abel Wolman, Chief Engineer, Maryland State Department of Health, 2411 N. Charles St., Baltimore, Md., and A. E. Gorman, Wallace & Tiernan Co., Inc., Newark, N. J. Discussion led by Robert Spurr Weston, Consulting Sanitary Engineer, 14 Beacon St., Boston, Mass.; George W. Fuller, Consulting Engineer, 170 Broadway, New York, N. Y.

Private Cross Connections and Similar Menaces to Quality of the General Public Supply.
Setting out the surprising commonness and variety of ways in which faulty arrangements on consumers premises may pollute an initially pure general supply.
Joel I. Connolly, Chief, Bureau of Sanitary Engineering, Chicago Department of Health, Chicago, Ill. Discussion led by William C. Groeniger, Consulting Sanitary Engineer, 503 Franklin Bldg., Columbus, O.; S. B. Morris, Chief Engineer, Water Department, 319 City Hall, Civic Center, Pasadena, Calif.; F. Gardner Legg, Sanitary Engineer, Detroit Department of Health, Detroit, Mich.; H. H. Gerstein, Sanitary Engineer, Department of Public Works, 8140 Drexel Ave., Chicago, Ill.

TUESDAY AFTERNOON (Continued)

2:00 Conference of Committee No. 19, Boiler Feed Water Studies.
Sheppard T. Powell, Chairman, Chemical Engineer, 213 St. Paul Place, Baltimore, Md.

(A group of appropriate papers, not yet definitely arranged for, will be presented. These will be itemized in the final program.)

6:45 Dinner, Water Purification Division. Social and Entertainment Features Under the Direction of the Inimitable William J. Orchard.

WEDNESDAY FORENOON
Main Session

9:00 History of Steel Cylinder Reinforced Concrete Pressure Pipe in Europe.
Major Peter C. Bullard, U. S. District Engineer, Duluth, Minn. Discussion led by F. F. Longley, Lock Joint Pipe Co., Box 21, Ampere, N. J.

Steel Trunk Lines with Bell and Spigot Joints.
William W. Hurlbut, Water Distribution Engineer, Department of Water and Power, 207 S. Broadway, Los Angeles, Calif.

WEDNESDAY FORENOON
Main Session (Continued)

Two Interesting Failures of Welds on Small Patches in Large Steel Pipe.
Illustrated by Lantern Slides.
A brief paper describing operating experiences with steel pipes in which holes cut for test specimens are closed with welded patches.
W. W. Brush, Chief Engineer, Department of Water Supply, Gas and Electricity, Municipal Bldg., New York, N. Y.

Cast Iron Pipe after 260 Years' Service in Gardens of Versailles, France.
Illustrated by Lantern Slides.
A brief paper describing the features of general interest in this historic installation.
Burt B. Hodgman, C. E., National Water Main Cleaning Co., 50 Church St., New York, N. Y.

Disaster Preparedness Plans for Water Works.
Dealing with the making of advance plans to meet possible catastrophes such as earthquake, flood or conflagration.
George W. Pracy, Superintendent of City Distribution Division, San Francisco, Water Department, San Francisco, Calif. Discussion led by E. L. Filby, Chief Sanitary Engineer, State Board of Health, Jacksonville, Fla.; John H. O'Neill, Sanitary Engineer, Louisiana State Board of Health, New Orleans, La.; S. B. Morris, Chief Engineer, Water Department, 319 City Hall, Civic Center, Pasadena, Calif.

WEDNESDAY FORENOON (Continued)
Water Purification Division

Frank E. Hale, Chairman, Director of Laboratories, Department of Water Supply, Mt. Prospect Laboratory, Brooklyn, N. Y.

9:30 Successful Application of Superchlorination and Dechlorination for Medical Taste to a Well Supply, Jamaica, N. Y.
Illustrated by Lantern Slides.
Unusual cause for Medicinal Taste probable. Short contact period for Superchlorination. Very simple control.
Frank E. Hale, Director of Laboratories, Department of Water Supply, Mt. Prospect Laboratory, Brooklyn, N. Y. Discussion led by Alan M. E. Johnstone, Manager, New York District, Wallace & Tiernan Co. Inc., 233 Broadway, New York, N. Y.; George R. Spalding, Asst. Supt., Filtration and Sanitation, Hackensack Water Co., New Milford, N. J.

WEDNESDAY FORENOON
Water Purification Division (Continued)

Progress in Superchlorination treatment for Taste Prevention at Toronto together with some studies on Chlorine Absorption.
Installation of one-ton containers and evaporators, effect of phenol on chlorine absorption in a polluted water.
N. J. Howard, Director of Water Purification, Island Filtration Laboratories, 410 Lake Shore Drive, Toronto, Ont. Discussion led by Linn H. Enslow, Research Engineer, The Chlorine Institute, Inc., 30 E. 42nd St., New York, N. Y.; Harry E. Jordan, Sanitary Engineer, Indianapolis Water Co., 113 Monument Circle, Indianapolis, Ind.

Chemical and Mechanical Utilization of Activated Carbon in Water Purification.
Illustrated by Lantern Slides.
Discussion of proper design and operation of suitable equipment, novel applications of activated carbon suggested.
A. S. Behrman, Chemical Director, and H. B. Crane, Principal Asst. Engineer, International Filter Co., 333 W. 25th Place, Chicago, Ill. Discussion led by Paul Hansen, Consulting Engineer, Pearse, Greeley & Hansen, 6 N. Michigan Ave., Room 1710, Chicago, Ill.

The Use of Activated Carbon for the Removal of Taste and Odor from Water.
Results of experiments with activated carbon of water containing taste and odors due to mixed industrial wastes.
George D. Norcom, Sanitary Engineer, Federal Water Service Corporation, 27 William St., New York, N. Y. Discussion led by Robert Spurr Weston, Consulting Sanitary Engineer, 14 Beacon St., Boston, Mass.

Further Observations on the use of Activated Carbon in Removing Objectionable Tastes and Odors from Water.
Illustrated by Lantern Slides.
Practical uses of activated carbon in filtration plants for dechlorination and removing objectionable compounds from water. Rates of filtration, depths of beds, methods for revivification.
John R. Baylis, Filtration Engineer, Bureau of Engineering, 1643 E. 86th St., Chicago, Ill. Discussion led by Charles P. Hoover, Chemist in Charge, Water Softening and Purification Works, Columbus, O.; W. A. Helbig, Chemist, Darco Sales Corporation, 45 E. 42nd St., New York, N. Y.

No papers will be presented Wednesday afternoon. Buses and guides will be available to take the members to the new Howard Bend plant of the city of St. Louis.

THURSDAY FORENOON
Main Session

9:00 Hydraulics of Deep Wells.
Dealing with the laws of flow into wells, mutual interference, economic spacing of wells and similar questions, including means by which existing data and theories may be made more useful than hitherto.
The late L. R. Balch, formerly of Mead & Seastone, Consulting Engineers, Madison, Wis. Discussion led by W. G. Kirchoffer, Hydraulic and Sanitary Engineer, 22 N. Carroll St., Madison, Wis.; Lafayette Higgins, Civil and Sanitary Engineer, 1144 W. 25th St., Des Moines, Ia.
Air Lift Pumps vs. Centrifugal and Other Deep Well Pumps.
Outlining the principal advantages and disadvantages of competitive means of pumping from deep wells with presentation of certion data on operating efficiencies and costs under service conditions.
C. N. Ward, Mead & Seastone, Consulting Engineers, Madison, Wis. Discussion led by A. P. Pigman, Mechanical Engineer, American Water Works & Elec. Co., 50 Broad St., New York, N. Y.; Major Thomas H. Allen, 1430 Bank of Commerce Bldg., Memphis, Tenn.
Importance of Proper Financing and Accounting in Water Works Practice.
A brief summary of the principal features in connection with finance and accounting and reasons why they are important, and outline of the aims of the new Finance and Accounting Division of the A. W. W. A.
H. Gordon Calder, Asst. Comptroller, Federal Water Service Corp., 27 William St., New York, N. Y. Discussion led by C. Van den Berg, President, Alabama Water Service Co., 1019 American Trust Bldg., Birmingham, Ala.; F. W. Schulz, Comptroller, Community Water Service Co., 46 Cedar St., New York, N. Y.
Mechanical Accounting for Water Utilities.
A general discussion with illustrative examples of the results obtained in certain water departments.
P. H. Hutchinson, Burroughs Adding Machine Co., 1 Park Ave., New York, N. Y. Discussion led by L. M. Anderson, Controller, Department of Water and Power, 207 S. Broadway, Los Angeles, Calif.; Hal H. Smith, Head Clerk, Water Consumers Accounts, Department of Water Supply, Detroit, Mich.

THURSDAY FORENOON
Main Session (Continued)

Problems of Water Utility Finance.
Contains suggestions as to handling various problems of water utility financing, including financing water main extensions.
A. P. Michaels, General Manager, Orlando Utilities Commission, Orlando, Fla. Discussion led by E. W. Agar, Superintendent Water Department, Valparaiso, Ind.; R. O. Drummond, Federal Water Service Corp., 27 William St., New York, N. Y.

THURSDAY FORENOON (Continued)
Water Purification Division

9:00 Some Neglected Dangers to Water Quality.
Attention called to other dangers than typhoid fever, such as parasites, resulting in serious difficulties in other countries though not yet in the United States.
Jack J. Hinman, Jr., Associate Professor of Sanitation, University of Iowa, Iowa City, Ia. Discussion led by Professor Edward Bartow, University of Iowa, Iowa City, Ia.
Unusual Color Removal Plant for part of the Los Angeles Water Supply.
Use of ferric chloride to remove color of 125 ppm., modified filtration unit for best results, new principle of "sludge return." Methods adopted to combat Crenothrix.
Carl Wilson, Laboratory Director, Department of Water and Power, Los Angeles, Calif. Discussion led by Linn H. Enslow, Research Engineer, The Chlorine Institute, Inc., 30 E. 42nd St., New York, N. Y.; J. S. Whitener, Assistant Professor of Sanitary Engineering, North Carolina State College, Raleigh, N. C.
The Trial Filtration Plant, Ottawa, Canada.
Trial filter justified by satisfying authorities and public that a colorless, tasteless water could be obtained at reasonable cost, by satisfying designers as to best methods. Operating personnel familiar with completed plant.
George G. Nasmith, Consulting Civil Engineer, Gore, Nasmith & Storrie, Confederation Life Bldg., Toronto 2, Ont. Discussion led by W. E. MacDonald, City Water Works Engineer, 21 Fourth Ave., Ottawa, Canada.
Prechlorination in Relation to Filter Plant Efficiency.
Illustrated by Lantern Slides.
Comparative experimental study at the U. S. Public Health Service experimental plant at Cincinnati over a period of 15 months.
H. W. Streeter, Sanitary Engineer, U. S. Public Health Service, Third and Kilgour Sts., Cincinnati, O. Discussion led by Linn H. Enslow, Research Engineer, The Chlorine Institute, Inc., 30 E. 42nd St., New York, N. Y.; Ralph A. Stevenson, Superintendent of Filtration, 3425 V St., Sacramento, Calif.

THURSDAY AFTERNOON
Water Purification Division (Continued)

Observations on Filter Sand Shrinkage.
A further account of what has been done at Detroit to discover cause and minimize trouble.
W. M. Wallace, Superintendent of Filtration, and Roberts Hulbert, Senior Chemist, Department of Water Supply, Detroit, Mich. Discussion led by Charles R. Cox, Asst. Sanitarian, Department of Health, Albany, N. Y.; Lyle J. Jenne, Sanitary Engineer, Bureau of Water, Department of Public Works, Philadelphia, Pa.
Manipulation of pH at Springfield, Ill., Water Purification Plant.
Illustrated by Lantern Slides.
Observations on sterilizing and coagulating values of excess lime, and practical application of flue gas at this plant.
Charles H. Spaulding, Chemist and Superintendent Water Purification, Department of Water, Light and Power, Springfield, Ill. Discussion led by John D. Fleming, Chief Chemical Engineer, Howard Bend Station, Water Division, St. Louis, Mo. (Route 25, Chesterfield, Mo.); Charles P. Hoover, Chemist in Charge, Water Softening & Purification Works, Columbus, O.

THURSDAY AFTERNOON
Main Session

2:00 The Advance Planning and Operating Results of Pumping Facilities at Chicago.
The studies and estimates involved in selecting pumping arrangements in relation to the results later obtained in service.
Loran D. Gayton, City Engineer, 402 City Hall, Chicago, Ill. Discussion led by L. A. Day, Water Commissioner, 312 City Hall, St. Louis, Mo.; W. C. Rudd, Asst. Engineer, Power, Department of Water Supply, 8100 W. Warren Ave., Detroit, Mich.; Leon Small, Superintendent Engineering Division, Department of Public Works, Baltimore, Md.
Wastefulness and its Correction in Operation of Pumping Stations.
Discussing the commonest sources of wastes in pumping stations and methods by which fuel costs have been reduced as much as one-half without replacing the main equipment.
A. P. Pigman, Mechanical Engineer, American Water Works & Elec. Co., 50 Broad St., New York, N. Y. Discussion led by L. A. Day, Water Commissioner, 312 City Hall, St. Louis, Mo.; A. D. Couch Mechanical Engineer Community Water Service Co. 46 Cedar St., New York. N. Y.; Kurt Toensfeldt, Combustion Engineering Corp., 200 Madison Ave., New York, N. Y.

THURSDAY AFTERNOON
Main Session (Continued)

Diesel Engines as Applied to Water Works Service.
Dealing with the extent of use, general status and principal features of interest of Diesel engines in water works service with some examples of operating results.
R. D. Hall, Manager, Water Works Sales, Worthington Pump & Machinery Corp., 2 Park Ave., New York, N. Y. Discussion led by F. G. Gordon, Consulting Engineer, Monadnock Block, Chicago, Ill.; Arthur L. Mullergren, Consulting Engineer, 770 Board of Trade Bldg., Kansas City, Mo.; A. D. Couch, Mechanical Engineer, Community Water Service Co., 46 Cedar St., New York, N. Y.
Obtaining Water Level Readings by Automatic Telephone.
A brief description of automatic devices used at Washington, D. C., to employ ordinary telephone circuits in transmitting water level readings from remote reservoirs to pumping stations.
Dewey M. Radcliffe, Associate Engineer, U. S. Engineer Office, Washington, D. C.
Business Meeting of Plant Management and Operation Division.

THURSDAY AFTERNOON (Continued)
Water Purification Division

2:00 Efficient Water Works Operation and the Purification Laboratory.
Illustrated by Lantern Slides.
Evaluates the Laboratory as an effective unit for economical efficient water works operation. Examples of Laboratory control producing considerable operating savings.
Martin E. Flentje, Superintendent of Purification, Supervising Engineers, Inc., 600 N. Second St., Harrisburg, Pa., and P. S. Wilson, Superintendent of Operation, Community Water Service Co., 46 Cedar St., New York, N. Y. Discussion led by L. T. Reinicker, Operating Manager, National Water Works Corp., 524 Washington St., Reading, Pa.; William U. Gallaher, General Chemical Co., 300 W. Adams St., Chicago, Ill.
Elimination of Taste in the Water Supply of Lancaster, Pa.
Experience with the use of ammonia with chlorination.
Edward D. Ruth, 135 S. Duke St., Lancaster, Pa. Discussion—

THURSDAY AFTERNOON
Water Purification Division (Continued)

Preammoniation of the Water Supply of Cleveland, O.
Large plant installation of ammonia equipment for eliminating taste and odor with chlorination. Point of application, dosage, etc.
J. W. Elims, Engineer Water Purification & Sewage Disposal, Department of Public Utilities, Cleveland, O. Discussion led by Howard J. Pardee, The Pardee Engineering Co., 23-14 44th Road, Long Island City, N. Y.
Effects of Colloids on Coagulation.
Illustrated by Lantern Slides.
Colloids determined and nature studied in a colored and a turbid water. Effect of these colloids on coagulation requirement determined. Necessity of adjusting treatment indicated.
C. H. Christman, Filtration Department, National Aluminate Corp., 6216 W. 66th Place, Chicago, Ill. Discussion led by Thorndike Saville, Professor of Hydraulic and Sanitary Engineering, University of North Carolina, Chapel Hill, N. C.; Sheppard T. Powell, Chemical Engineer, 213 St. Paul Place, Baltimore, Md.
The Elimination of Coli-aerogenes Contamination, due to Pump Packing, from a High Pressure Centrifugal Pump.
Growth of Coli-aerogenes on pump packing.
Arthur F. Mellen, Filtration Engineer, Columbia Heights Filtration Plant, Minneapolis, Minn. Discussion led by Fred O. Tonney, Director of Laboratories and Research, Department of Health, 712 City Hall, Chicago, Ill.
Exhibit of Cyanide-Citrate Agar for Direct count of B. coli and B. aerogenes, with short description of improved simpler method of preparation.
Fred O. Tonney, Director of Laboratories and Research, Department of Health, 712 City Hall, Chicago, Ill.

FRIDAY FORENOON
Main Session

9:00 Training Operating Personnel for Small Purification Works.
Methods for instructing and directing non-technical operators and as a collateral subject the placing of small water and sewage purification works, where occurring in the same community, under a single technical head.
J. S. Whitener, Asst. Professor of Sanitary Engineering, North Carolina State College of Agriculture and Engineering, 1202 Cowper Drive, Raleigh, N. C. Discussion led by Abel Wolman, Chief Engineer, Maryland State Department of Health, 2411 N. Charles St., Baltimore, Md.; E. S. Tisdale, Director, West Virginia State Department of Health, Charleston, W. Va.; H. E. Miller, Chief Engineer, North Carolina State Board of Health, Raleigh, N. C.; Thomas R. Lathrope, Asst. Engineer, Ohio State Department of Health, Columbus, O.
Operating Experiences with a New Automatic Residual Chlorine Recorder and Controller.
Summarizing about one year's continuous

and successful operation with a new device at Little Falls, N. J., by which the residual chlorine content is automatically controlled and recorded.

J. Westford Cutler, Experimental Engineer, Wallace & Tiernan Co., Inc., Newark, N. J., and Frank W. Green, Superintendent of Filtration and Pumping, Passaic Consolidated Water Co., Little Falls, N. J. Discussion led by J. H. Harrington, Chemist, Montreal Filtration Works, Montreal, Que.

Development of a Water Distribution System for Greater Detroit.

F. H. Stephenson, Engineer of Water System, 735 Randolph St., Detroit, Mich. Development of a Water Distribution System for Greater St. Louis.

Thomas J. Skinner, Engineer in Charge of Distribution, 4600 McRee Ave., St. Louis, Mo.

These two papers relating to Detroit and St. Louis describe the means employed and the principles involved in comprehensive planning of distribution trunks and feeders with reference to present and future needs.

Discussion of two papers in common by Louis E. Ayres, Ayres, Lewis, Norris & May, Engineers, Cornwell Bldg., Ann Arbor, Mich.; J. B. Eddy, Engineer, Water Pipe Extension, 104 City Hall, Chicago, Ill.; V. Bernard Siems, Vice-President and Chief Engineer, National Water Works Corp., 11 Broadway, New York, N. Y.

FRIDAY FORENOON

Finance and Accounting Division

H. Gordon Calder, Chairman, Asst. Comptroller, Federal Water Service Corp., 27 William St., New York, N. Y.

A series of papers and discussions of interest to water works accounting officials, the details of which will appear in the final program, will be provided.

FRIDAY AFTERNOON

Main Session

2:00 Water Supply for Airports.

Dealing with the substantial quantity of water required for fire protection and the presence of unusually inflammable materials as related to the usually inadequate feeder supply to airports and the rapidly increasing number of such ports.

S. F. Newkirk, Jr., Superintendent and Engineer, Elizabethtown Water Co., Consol., 46 Broad St., Elizabeth, N. J. Discussion led by Clarence Goldsmith, Asst. Chief Engineer, National Board of Fire Underwriters, 222 W. Adams St., Chicago, Ill.; Herman Rosentreter, Engineer of Water Supply, City Hall, Newark, N. J.

Investigation of Service Pipes of Various Materials.

Dealing principally with friction loss tests with particular reference to the carrying capacity of copper tubing in comparison with other classes of pipe.

R. W. Reynolds, Superintendent, West Palm Beach Water Co., West Palm Beach, Fla. Discussion led by J. E. Gibson, Manager and Engineer, Water Department, 14 George St., Charleston, S. C.; S. H. Taylor, Superintendent, Water Department, 312 Municipal Bldg., New Bedford, Mass.; Seth M. Van Loan, Deputy Chief, Bureau of Water, 709 City Hall, Philadelphia, Pa.

Water Requirements of Cities in Arid and Semi-Arid Climates.

The effect of climate on requirements of representative western and southwestern cities having relatively dry or hot and dry summers, with special reference to irrigation needs.

N. T. Veatch, Jr., Consulting Engineer, 701 Mutual Bldg., Kansas City, Mo. Discussion led by Burton Lowther, Consulting Engineer, 723 Colorado Bldg., Denver, Colo.; V. M. Ehlers, Chief Sanitary Engineer, Texas State Department of Health, Austin, Tex.; Richard Bennett, Superintendent Water Department, Tucson, Ariz.

Sand Spun Pipe and Its Method of Manufacture.

Warren A. Brown, Engineer, R. D. Wood & Co., Philadelphia, Pa.

FRIDAY AFTERNOON (Continued)

2:00 **Finance and Accounting Division.**

A series of papers and dscussions of interest to water works accounting officials, the details of which will appear in the final program, will be provided.

Boring Machine Saves Cost of Trenching for Pipes

The accompanying photographs illustrate a machine for boring under paved roads to permit the installation of pipes, developed by the gas distribution department of the Rochester Gas & Electric Corp., Rochester, N. Y.

The machine, according to L. H. East, assistant superintendent of the gas distribution department, consists of (1) a boring tool varying from 3 to 8 in. in diameter; (2) a Ford differential mounted on a carriage, used to transfer the rotation of a vertical shaft into rotatory motion of the horizontal shaft and also as a speed reducer, and (3) a motor driven with air furnished by a portable compressor. The carriage runs on a plank track, and the machine is moved along the track as the hole is advanced.

This machine has found considerable use and has proved quite satisfactory for most types of soil. Holes up to 8 in. in diameter have been bored under 24-ft. pavements, through clay, hardpan and even clay containing small boulders. In the process of cutting a hole, the tool is fed in for a distance of about 2 ft., after which it is withdrawn and the earth removed. This operation is repeated until the width of the pavement has been penetrated. When working in hard clay, it has sometimes been found advantageous to bore a pilot hole about 3 in. in diameter first and ream this hole out with one or two reamers. Where the soil contains stone and small boulders, these obstacles can often be moved and turned so that they can be removed from the hole.

A Definition of Civil Engineering

For the purpose of the administration of the state act for registration of civil engineers, the State Board of Registration of California adopted the following definition: Civil engineering is that branch of professional engineering which deals with the economics of, the use and design of, the materials of construction and the determination of their physical qualities; the supervision of the construction of engineering structures; and the investigation of the laws, phenomena, and forces of nature; in connection with fixed works for:

Irrigation
Drainage
Water Power
Water Supply
Flood Control
Inland Waterways
Harbors
Municipal Improvements
Railroads
Highways
Tunnels
Airports and Airways
Purification of Water
Sewerage
Refuse Disposal
Foundations
Framed and Homogeneous Structures
Bridges
Buildings.

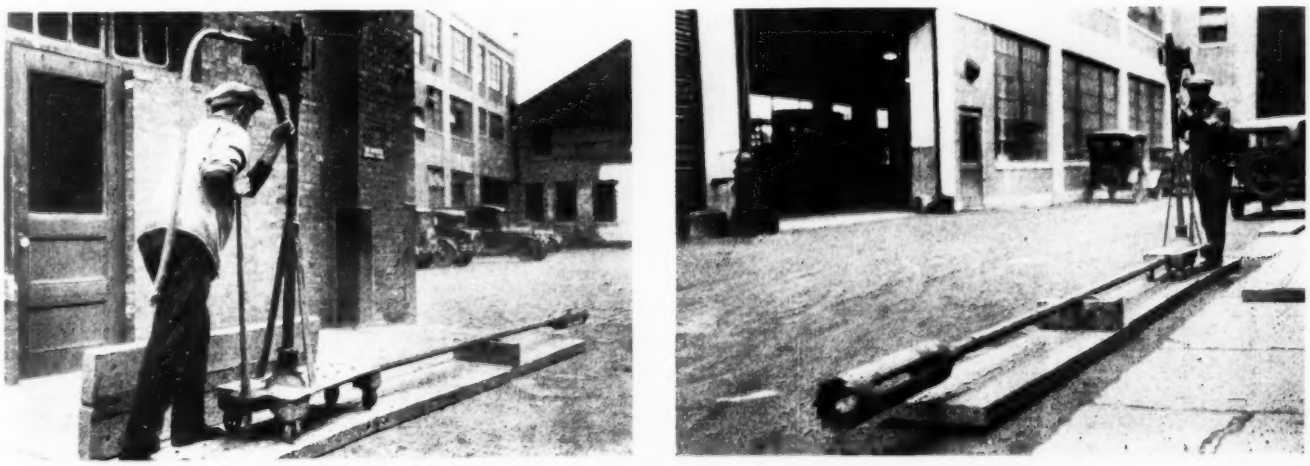
Furthermore, it includes:

City and Regional Planning

Valuations and Appraisals

Surveying, other than Land Surveying as defined in the General Laws of California, Chapter 247, Statutes of 1907.

Town Water Supplies in Virginia.—Of the 152 incorporated towns in Virginia, 83 have a town water supply.



Two Views of Pipe-Installing Machine Devised by Rochester Gas & Electric Corp.

New Books

"Water Supply Engineering," by Harold E. Babbit, Professor of Sanitary Engineering, University of Illinois, and James J. Doland, Assistant Professor of Sanitary Engineering, University of Illinois. First edition, 776 pages, 5¾ in. by 9 in., cloth hard binding. McGraw-Hill Book Company, New York, publishers. Price, $6.00.

The authors have produced a comprehensive treatment of water supply engineering in this work. They intended it to be used as a text book for civil engineering class work, but have gone entirely too much into detail except for a specialized course. Throughout the book they quote freely from their sources of information. This is a very commendable feature of the book. It is profusely illustrated, which is another excellent feature; especially where the book is used to teach the subject to students.

The authors state that the volume is not intended as a comprehensive treatise on water works, nor as a handbook, yet it certainly fills that bill to a great extent. The pure theory of water works engineering, if supplemented by examples in class work to illustrate the point under discussion, will leave the student more open-minded and receptive to new developments. The book is undoubtedly a valuable addition to the already rich supply of water works data.

"The Balancing of Engines," by W. E. Dalby, Professor of Engineering, Imperial College of Science and Technology, London. Fourth edition, 326 pages, 6 in. by 9 in.; cloth board covers. Longmans, Green & Co., New York City, publishers. Price, $8.40.

Since the first edition of this book was brought out in 1902 there have been great changes in the design of machines to which the theory of balancing applies, but the author's original method of solving balancing problems and of finding the balancing weights in a practical way on the drawing board has been found effective. In this fourth edition the method is continued, with amplification of the data and experience gained by research.

The number of machines for testing unbalance that have been brought out within the last few years is one measure of the importance now being given this matter by engineers. In automobiles the car buyer looks for something near perfect balance to give him freedom from vibration, noise, and excessive wear. Bridge constructors look for balanced locomotives to reduce the required allowances for hammer blow, torsional oscillation, and swaying. The designer of ordinary industrial machines must also balance the rotating parts if he is to obtain the quiet operation now demanded by the users. This book is an outstandingly complete treatise on the subject for the technical designer. It divides the subject into logical chapters, illustrating each with ample examples and drawings.

"Sewerage and Sewage Disposal," by Leonard Metcalf and Harrison P. Eddy. Second edition, 783 pages, 5¾ in. by 9 in.; cloth bound board cover. McGraw-Hill Book Co., New York City, publishers. Price, $6.00.

This is a revision of the book by the same authors which was put out in 1922. However, it has been built with the object in view of having it serve better as a text book. Even as it is, it is too voluminous.

The following table of contents gives an excellent idea of what is treated:

Chapter I—Introduction and general discussion.

Chapter II—Quantity of sewage, methods of predicting and estimating flow.

Chapter III—Quantity of storm water, how gauged.

Chapter IV—Hydraulics of sewers, flow of water, comparison of formulae.

Chapter V—Design of sewers, calculations necessary and economic considerations.

Chapter VI—Sewer appurtenances and special structures, discussion of equipment.

Chapter VII—Preliminary investigations, surveying and inspection.

Chapter VIII—Pipe and masonry sewers, properties, strength tests and joints.

Chapter IX—Load on sewers, live and dead, research investigations.

Chapter X—Excavation, sheeting and bracing of trenches, trenching machinery and underdrains.

Chapter XI—Characteristics and behavior of sewage, chemical and organic composition, bacterial action.

Chapter XII—Sewage disposal by dilution, pollution, purification and disease prevention.

Chapter XIII—Sewage disposal by irrigation, sewage farming, land treatment.

Chapter XIV—Principles of sewage treatment, sedimentation, precipitation and digestion.

Chapter XV—Screens, grit chambers and skimming tanks, detritus tanks and grease traps.

Chapter XVI—Sedimentation basins, sludge digestion tanks, principles of operation and design.

Chapter XVII—Sewage filters, loading, grouping, dosing cycles and equipment.

Chapter XVIII—The activated sludge process, principles of operation, degree of purification, pumps and agitators.

Chapter XIX—Treatment and disposal of sewage sludge, volumes to be handled, methods of disposing of remainders.

Chapter XX—Chlorination of sewage, disposal of industrial wastes, and choice of sewage treatment and disposal methods.

Chapter XXI—Financial considerations, estimating, construction costs and bond issues.

This comprehensive volume is made very usable by a set of problems at the end of each chapter.

"The Yardstick of Public Utility Operations and Construction Costs," by William W. Handy, Consulting Engineer. 1929 edition, 155 pages, 8¾ in. by 11¾ in.; paper board binding. William W. Handy, Munsey Building, Baltimore Md., publisher.

Trends during substantially the last two decades of public utility operations by means of ratios and construction costs, by means of indices is presented in the book in understandable style. They are used in connection with such matters as financing of extensions and acquisitions, investment in securities, purchase, valuation and rate cases. The data is used in analyzing and reporting on companies.

Part I gives curves of composite relations of all the major financial and operating factors having to do with the operations of twenty of the major gas and electric operating companies, as distinguished from holding companies. Practical examples of how these relations can be used in investigating and reporting on other companies is given.

Part II presents by means of index numbers the trends in unit costs from 1911 to Jan. 1, 1929, inclusive, of all major elements of construction entering into the building up of gas and electric utilities. The text explains how these trends can be applied in determining values of proportions at existing prices from historic or book costs.

This is a "yardstick" in that it presents a measure of construction values to be used in practice.

This volume should prove of value to investment bankers or members of their analytical and statistical departments interested in public utility properties, public utility engineers and accountants, public utility officials, regulatory commissions and their staffs, public utility attorneys and, generally speaking, all critical investors in public utility securities.

"Business Law for Engineers," by C Frank Allen, M. Am. Soc. C. E., M. Mass. Bar, M. Am. Ry. Eng. Assn., formerly Prof. of R. R. Eng. Mass. Inst. Tech. Third edition, 475 pages, 6 in. by 9 in., cloth binding. McGraw-Hill Book Co., New York, publishers. Price, $4.

This is a revision of previous editions of the same work, which consists in additions thereto. The author states that a more extended use of cost-plus contracts seems to justify a special chapter on the subject.

This book covers one phase of engineering and construction work about which executives are prone not to acquaint themselves. Engineers and contractors often get into difficulty and try to get out rather than take precautionary measures and avoid getting into the difficulty. One chapter on "The Engineer's Legal Relations with Others" should be digested by all engineers engaged in the profession.

Pipe Handling and Back Filling Unit

The W-K-M boom and side winch is now being manufactured for mounting on the Model DH Trackson McCormick-Deering. This equipment, which is made by the W-K-M Co., Inc., Houston, Tex., greatly increases the versatility and usefulness of the Trackson unit. With the W-K-M boom it is adaptable to backfilling, by the use of a throw-back bucket or Mormon board, pipe handling and laying, and other similar operations.

This combination of equipment is stated to lift and carry loads of 4500 lb. and will raise much heavier loads when stiff-leg is used.

The boom may be mounted on the tractor quickly and easily in the field, since the installation requires no drilling or cutting. An outstanding advantage is the fact that the boom when installed does not interfere with the use of the Trackson McCormick-Deering for drawbar operations.

The W-K-M equipment is made of best quality steel castings throughout. The normal length of the boom is 13½ ft.; extended, its maximum length is 19 ft. The side winch has two drums, each with a capacity for 495 ft. of ½-in. cable. The clutches are of the internal expanding, two-shoe friction type, 13¾ in. in diameter and each 35 in. long. All shocks and strains to the boom and side winch are absorbed by "A" frames provided at each side of the tractor, and the equipment is provided with ball and socket joints throughout to overcome strain through track oscillation.

Mormon boards, special sheaves, stiff legs, pipe hooks for various sizes of pipe and other extra equipment for this unit may also be obtained. Either the Trackson Co., Milwaukee, Wis., or the W-K-M Co., Inc., Houston, Tex., will furnish complete information on request.

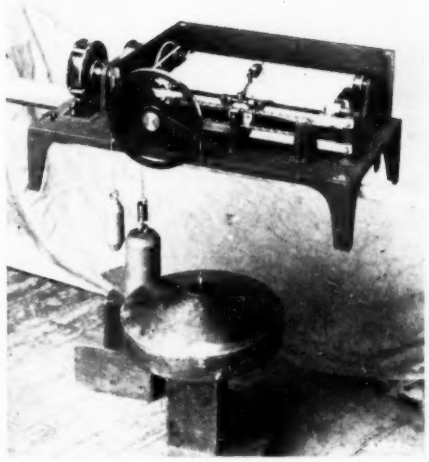
W-K-M Boom and Side Winch Mounted on Model DH Trackson McCormick-Deering

A New Water Level Recorder

Automatic recording devices are rapidly replacing the old method of intermittent observations by a local observer. A new recorder, the Stevens Type A30, combines a float-operated pencil with a continuous roll of graduated paper moved by a weight driven clock. The vital parts are hermetically sealed when in service. This precludes entry of dust and bugs, and largely eliminates errors from expansion and contraction of the paper by humidity changes—an important consideration in moist climates.

The supply roll contains 25 yd. of recorder paper—sufficient for a year's record. The paper has perforations on the margin which mesh with spines on the driving cylinder, thus preventing slippage and lateral displacement. The used paper is taken up on a roller turned by a spiral spring belt from the driving cylinder that keeps the paper gently taut at all times.

Another important feature is the non-slip float line of light non-corrosive metal with tiny brass balls uniformly spaced on it. The balls match recesses in the grooved float pulley. The line with its balls weighs only 6 oz. per 100 ft., yet is strong enough to lift 400 lb.



Stevens Type A30 Recorder

This recorder is regularly equipped to run two months with one setting, but may be equipped for a run of six months or even a year if desired. It is manufactured by Leupold, Volpel & Co., 267 Washington St., Portland, Oregon, and is fully described in their new edition of Bulletin 12 just off the press.

New Motor Housing for Turbine Centrifugal Pump

Ever since the introduction of turbine centrifugal pumps requiring vertical motors, no concerted attempt has apparently been made to design the motor housing as an integral part of the pump, according to H. G. Steele, president of the U. S. Electrical Manufacturing Company. Heretofore, the base of the pump resting upon the concrete at the surface of the ground, was designed by the manufacturer to meet his needs and when the motor was set upon the pump, according to Mr. Steele, sometimes made an awkward assembly that was both ugly and not in keeping with good engineering practice.

U. S. Electrical engineers some time ago began the study of electric motor construction as applied specifically to turbine centrifugal pumps, and finally developed a new motor housing which will be known as the U. S. Turbo Pump Motor. None of the operating units is exposed and the motor is said to be weatherproof. It is designed with the operating parts fully protected and is symmetrical. When set upon the pump base it is said to offer a very pleasing appearance. Literature describing the new pump motor may be obtained by anyone interested in water pumping design from the manufacturers, whose address is 200 E. Slauson Ave., Los Angeles, or from any of the concern's distributing offices.

New Offset Vertical Boom Ditcher

One of the outstanding attractions at the recent convention of the American Gas Association at Atlantic City was a new ditcher, exhibited by the Barber-Greene Co. of Aurora, Ill.—a light ditcher with an offset vertical boom. The offset boom is not offset in any fixed position but may be set at any desired position between the crawlers on which the machine is mounted, and locked there.

This new product of the Barber-Greene Co. is patterned generally after the well known standard vertical boom ditcher, and there are several noteworthy features incorporated in its design.

The vertical boom—a patented Barber-Greene feature—has become familiar to ditching contractors on the larger B-G Model 44-C ditcher.

Another feature of the new utility ditcher is the automatic overload safety sprocket. This affords protection for the machine against overloads, and for pipes and other underground installations against breakage which would prove expensive to the contractor. When an obstruction is encountered, the sprocket slips, stopping the bucket line, catches every half revolution, then slips again. This action will continue without harm to the machine until the obstruction has been removed, or the buckets have milled through it.

The boom is raised and lowered by power, and an automatic throw-out makes it impossible to raise the boom too high.

The whole machine is mounted on sturdy crawlers of standard Barber-Greene design by means of a fixed and an oscillating axle. The oscillating axle provides three-point suspension for the machine, which enables it to ride over rough ground and stay on an even keel.

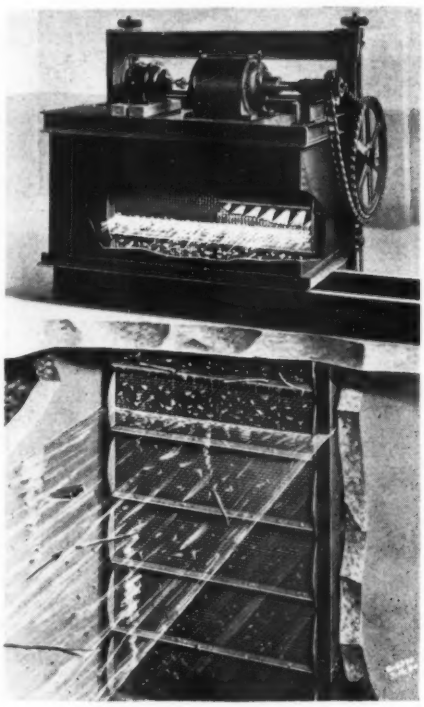
The machine is powered with a Buda 38 hp. gasoline engine and is driven through two especially designed transmissions. It has four road speeds—three forward and one reverse, with a high forward speed of 2⅛ miles per hour—and a great number of digging speeds ranging from 12 in. to 148 in. per minute. There are cutting speeds to suit any soil condition.

New Barber-Greene Light Ditcher

The Utility Ditcher cuts a trench from 9 in. to 18 in. wide and from 4 ft. to 5 ft. 6 in. deep. It is light, compact and sturdy.

New Traveling Water Screen

A new type of traveling water screen embodying many new features has been put on the market by the Chain Belt Co., Milwaukee, Wis. This new screen is an entirely new development at the company and will be built at the company's plant at West Milwaukee. While the general principle of traveling water screens will be maintained the outward appearance of the screen itself has been definitely changed. It will occupy less space than heretofore. Another of its improvements is its accurate sealing and operating features.



New Traveling Water Screen

The two major improvements consist of a new basket design and a new base.

These rectangular baskets hold the screen cloth (which may be of various constructions) and are in turn carried by two strands of Rex Chabelco hardened steel roller chain. The chain operates over head and foot sprockets. As the submerged screen surface becomes matted with the refuse, the screen is revolved. The refuse is then lifted from the intake by the upward travel of the baskets and is automatically removed by means of a powerful spray of water directed through the baskets from their rear, and which washes this refuse into a refuse trough. The spray of water serves to sluice the screen material away for disposal, usually on the down-stream side of the plant.

The second major improvement is the radically new design of the foot wheel, which permits the use of the new extended track shoe. This shoe engages the roller at the exact instant that it leaves the wheel. There is no intervening space in which the roller can weave inward, causing openings between the ends of the baskets and the frame of the screen.

Apparatus for Analysis of Water and Sewage

The accurate analysis of water, sewage and industrial waste always has been an important factor for water and sanitary engineers. Until a short time ago the colorimetric tests were hindered by the inconvenience of preparing and rechecking the liquid comparison standards which are said to fade more or less in the course of time. The accompanying illustration shown is water test comparator with permanent color glass standards, made by Hellige-Klitt, Mo., 179 East 87th St., New York, N. Y.

The Hellige comparators for water analysis, hydrogen in control and many other tests have cells or tubes with plane and parallel walls and a prism arrangement which brings the color fields into juxtaposition. It is stated that working with these comparators is very simple and that tests can be made without any special training after a few minutes reading of the directions. No readings from tables or calculations are necessary. The color disc is just revolved until a standard matches with the test solution and the result read directly by a number appearing through an opening in a front of the apparatus.

In addition to the color glass standards for the analysis of water, sewage and industrial wastes, permanent color glass standards are available for hydrogen ion control and many other tests.

Hellige Comparator and Glass Standards

TO GIVE THE PEOPLE THE MODERN, CONVENIENT TELEPHONE SERVICE THAT THEY NEED

The Bell Telephone Company . . . of your town

An Advertisement of the American Telephone and Telegraph Company

IT HAS its home in your town. Its operators are the daughters of your neighbors. Its various departments are in the hands of your own citizens, with years of training in telephone engineering and management. Who owns the Bell System? 450,000 people scattered over the United States own the stock of the American Telephone and Telegraph Company and 250,000 own other securities of the Bell System.

No matter how small the part of the Bell System that serves you, it has behind it research, engineering and manufacture on a national scale. The Bell System operates through 24 companies, each designed to fit the particular area it serves—to furnish the highest standard of service in a manner personal to the needs of every user.

Serving each of these 24 operating companies is the staff of the American Telephone and Telegraph Company, which is constantly developing better methods of telephone communication. Each draws on the findings of the Bell Laboratories, one of the greatest institutions of its kind in the world, for the continual scientific improvement of telephone service.

Each has the benefit of the buying power and specialized manufacturing processes of the Western Electric Company, which supplies telephone apparatus of the highest quality and precision for the entire Bell System.

Each takes advantage of every improvement in practice, equipment and economy.

The Bell System's ideal is to give all of the people of this nation the kind of modern, convenient telephone service that they want, over its wires to connect them one with another and with the telephones of the rest of the world. It is your telephone company, at your service with every resource that it commands.

DISTRIBUTOR NEWS

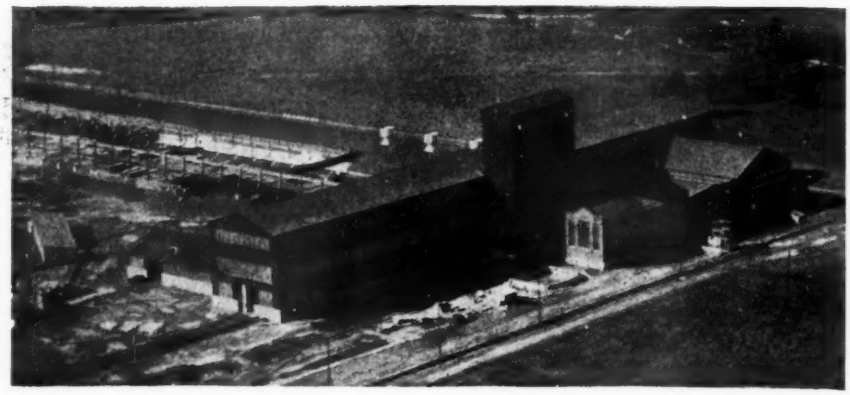
The Distributor's Department in the Gillette Construction Group

Chicago Bridge & Iron Works Buys Large Southern Plant

The Chicago Bridge and Iron Works has purchased the Reeves Brothers Company steel plate fabricating plant in Birmingham, Ala., thus establishing a plant of their own in the south. In addition, the Chicago Bridge and Iron Works maintains plants in Chicago, Ill., and Greenville, Pa.

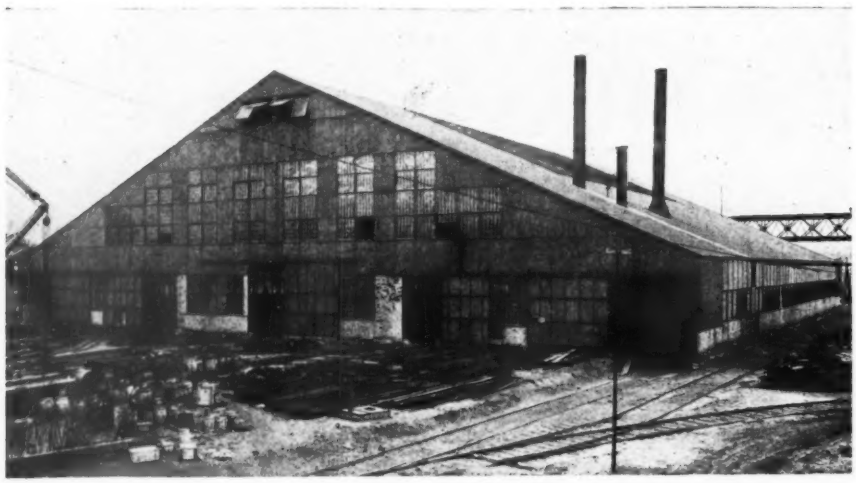
The Reeves Brothers plant was completed in 1925 and includes all of the modern developments and improvements in steel fabricating plants. It is located on a square 40-acre tract, a short distance from the main business district of Birmingham. E. E. Michaels, formerly assistant manager of operations in Chicago, is now located in Birmingham as manager, while the sales organization is under the supervision of James C. Vosburgh, former district sales manager of San Francisco. The major part of the local organization of the plant has been retained. In addition, quite a number of the employees of the main office in Chicago have been transferred to the Birmingham office. W. J. Lawson is foreman of the erection shop, while Fred J. Miller is the purchasing agent.

In reviewing the history of the company, it is found that the organization of the Chicago Bridge and Iron Works dates back to the early part of 1889, the charter being taken out on July 27. The formation of this company included the purchase of all business interest of the Kansas City Bridge and Iron Company. Kansas City was not deemed to be the logical location, so the plant was located in Chicago under the name of the Chicago Bridge and Iron Works.



Aerial View of Birmingham Fabricating Plant Recently Acquired from Reeves Brothers by Chicago Bridge & Iron Works

Main Plate Shop Building of Chicago Bridge & Iron Works (Horton Steel Works, Ltd.) at Bridgeburg, Ontario



An Early View of the Chicago Plant of the Chicago Bridge & Iron Works

Offices were located at Kansas City, Austin, Tex., St. Paul, Minn., and Chattanooga, Tenn. These outside offices were seeking contracts for highway bridges, the chief output of the plant at that time. On September 25, 1897, the plant was entirely destroyed by fire and the two alternatives offered were liquidation or rebuilding. Mr. Horton became sole owner of the company and formulated plans for a new plant in Washington Heights, which marks the present plant in Chicago.

Up to 1893, the business was solely confined to the building of bridges, but in the summer of 1893, the first standpipe was erected at Lake City, Ia., after

H. H. ROBERTSON CO.,
PITTSBURGH, PA.

THE MOST IMPORTANT INGREDIENT IN YOUR PIPE COATING IS

EXPERIENCE

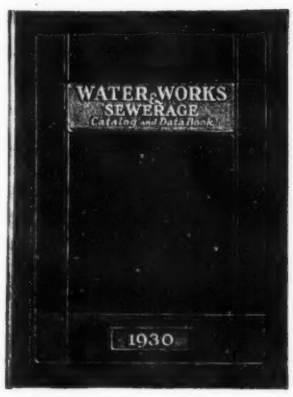
The best solution to any of the problems that come up in the business of coating pipes is knowledge. Robertson has the knowledge. The H. H. Robertson Co. is the world's largest producer of special asphalts. It has made investigations in the action of soils on coating materials. It can determine the exact combination of asphaltic bases that are best calculated to protect your pipe under any given set of conditions . . . and it can produce exactly that combination.

Specify Robertson coatings on your pipes.

ROBERTSON HAS THE EXPERIENCE

Announcing the 1930 edition of

WATER WORKS AND SEWERAGE CATALOG AND DATA BOOK



Mister Reader!

Have you asked to have a copy of this Catalog reserved for you? It will be ready for distribution the 1st of June. The 1930 edition will be handsomely bound in dark maroon, leather finished, fabric.

This will be the second annual edition, which will appear as an independent volume, having no connection with the magazine of the same name.

Contents will be equivalent to a 250-page handbook of reference data. Information on Water Mains, Pumping Stations, Reservoirs, Sewage Works, Sewer Systems, Chlorination Meterage, Filtration Plants Operation.

Catalog descriptive of every type of equipment, material and chemical used in design, construction and operation of water works and sewerage.

GILLETTE PUBLISHING COMPANY
221 East 20th Street, Chicago

Gillette Publishing Co.
221 East 20th St., Chicago
Kindly reserve for me a complimentary copy of the 1930 edition of the Water Works and Sewerage Catalog and Data Book.

Name.....
Occupation
or
Title.....

Street Address.....

City.....State.....

which numerous orders were received for steel towers to support wood tanks. In 1894, the Company built its first hemispherical bottom steel tank. Prior to that time, elevated tanks consisted of a flat bottom wood or steel tank on an I-beam grillage mounted on a wooden or steel tower. The hemispherical bottom type is supported entirely by its connection with the bottom of the shell, the whole tank being supported by columns riveted directly to it. In 1907, the ellipsoidal bottom design was introduced, especially adapted to railroad service.

Installations increased in the eastern and southern districts. In 1910, a sales office was opened in New York and a plant in Greenville, Pa.; operation beginning in 1911. Interest was first aroused in Canada by the securing of a contract by Mr. Horton for the erection of a standpipe for the town of Pictou, N. S., in 1901. In 1913, business in Canada showed a marked increase. It was thought expedient to organize a company in Canada (Horton Steel Works, Ltd.), and Bridgeburg, Ontario, situated on the west bank of the Niagara river, was chosen as the location. Plant operation began in 1913, and the Bridgeburg plant has more than doubled its size. The main office is located at Bridgeburg, with branch offices at Montreal, Toronto, Winnipeg and Vancouver.

The Birmingham plant therefore, marks the third of the fabricating plants operated by the Chicago Bridge & Iron Works, thus serving the central states via Chicago, the eastern states via Greenville, and the southern area via Birmingham.

The building of oil storage tanks and general plate construction began in 1920. Hortonspheres, which are spherical pressure tanks, made their appearance in 1925. Wiggins Floating and Breather Roofs are another development, protecting oil tanks from evaporation and fire.

The Chicago Bridge and Iron Works has greatly increased its range of materials manufactured, and specializes in the design, construction and erection of oil tanks, elevated tanks, smokestacks, gasholders, penstocks. The plant in Birmingham is equipped to handle a larger range of steel work than the other U. S. plants, including the fabrication of agitators, absorbers, bubble towers, condenser boxes, crude stills, tank cars, blast furnaces, galvanizing kettles, steel mill ladles, rotary kilns, vertical kilns, creosoting cylinders, coke oven appliances and many other devices.

A. W. Daniels Made Vice-President American Manganese Steel Co.

The American Manganese Steel Co. announces the election of Mr. A. W. Daniels as vice-president in charge of sales, effective March 26, 1930.

Mr. Daniels was born in Chicago and educated in the Chicago elementary schools. At the age of thirteen he entered the "University of Hard Knocks" —the business world, where a wide diversification of experience in practically every branch of foreign and domestic commerce, manufacturing, accounting, finance, advertising, marketing, sales promotion and executive management prepared him well for the future demands which would be made on him.

For seven years prior to entering the employ of the American Manganese Steel Co. as assistant to the industrial engineer at the Chicago Heights plant, Mr. Daniels traveled extensively as a commercial representative. In 1920 he became the AMSCO Chicago office manager, a position that put him in intimate contact with the voluminous details of the manganese steel business. Two years later he was promoted to central sales manager, which position he occupied but one year before his appointment in 1923 as general sales manager of the American Manganese Steel Co.

Mr. A. W. Daniels

Mr. Daniels is an authority on the markets and marketing of manganese steel and is in complete touch with the developments of the industrial world as applied to the products of the American Manganese Steel Co., and because of his close, personal contact with the leaders of industry, and his keen analysis of business conditions, he is well fitted by experience and knowledge to fill this new position.

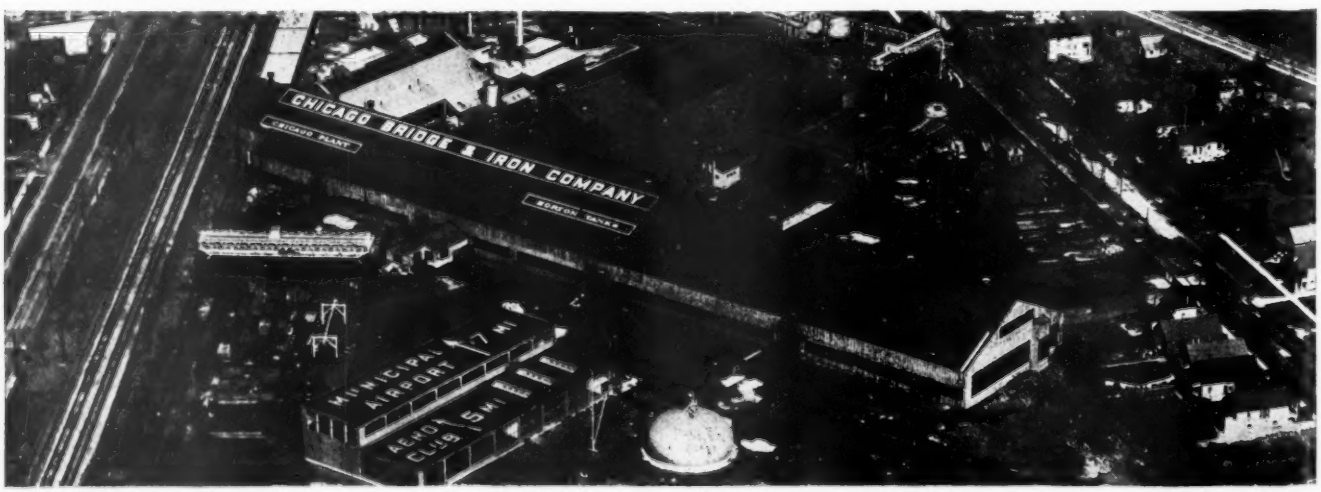
Link-Belt Announces New Crane Agents

Link-Belt Company, 300 West Pershing Road, Chicago, Illinois announce the appointment of the following agents who will handle their complete line of Crawler Cranes-Shovels-Draglines, and Locomotive Cranes.

P. L. Tippett, Rhodes Building, Atlanta, Georgia.

Jos. C. Fiorello Co., Larkin Terminal Bldg., Buffalo, New York.

Bacon-Hibbard-Eichman, Inc., 917 Central Avenue, Cleveland, Ohio.



Aerial View of Chicago Plant of Chicago Bridge & Iron Works in 1928

GOLDEN-ANDERSON

GOLDEN-ANDERSON

Patent Automatic Cushioned Controlling Float Valves

Adapted to automatically maintain a uniform water level in feed-water heaters, tanks, reservoirs, and pans. Very sensitive.

Operating on ½-in. to ¾-in. variation. No exhaust or expensive water waste. Can be furnished for hot or cold initial water supply. Reliable and dependable under varying pressure.

Sizes ½ in. to 24 in.

Automatic "Cushioned" Controlling Altitude Valves

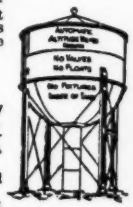
Cushion All Water Surges

Automatically maintains a constant stage of water in reservoirs, tanks and standpipes. They do away with the annoyances of Freezing Valves and Float fixtures inside of the Tanks or Floats and Fixtures outside of Tanks. "Three Ways of Closing These Valves."

1st—Automatically, by water.
2nd—By electricity, if desired.
3rd—By Hand.

May also be arranged to automatically close when a break occurs in the mains. When necessary they may be so connected as to "work both ways" on a single line of pipe.

The double cushion effect of air and water eliminates water hammer. There are no dangerous surges to burst water mains. **Write for details.**



REMEMBER Valves cushioned at all times by air and water. No water hammer or bursting mains.

"Made with stop starter attachment for centrifugal pumps."

Golden-Anderson Valve Specialty Co.

1385 Fulton Bldg., Pittsburgh, Pa.

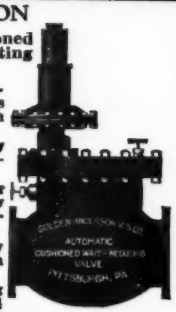
GOLDEN-ANDERSON

Patent Cushioned Water Relief Valves

1. Automatically relieve excess pressure.
2. Prevent stress, strain and bursting of mains.
3. Correct mechanical construction.
4. Perfect air and water cushioning.
5. No metal-to-metal seats. No hammering or shocks.
6. Angle and globe pattern. Sizes 3 to 24-in.

GOLDEN-ANDERSON

Pat. Automatic Cushioned Water Pressure Regulating Valves



1. Maintain a constant reduced pressure regardless of fluctuations on high pressure side.
2. Perfectly Cushioned by water and air. No metal-to metal seats.
3. The best valve made for maintaining a constant low pressure where consumption is continuous.
4. Operates quickly or slowly as required—No attention necessary.
5. Positively no hammering or sticking. Sizes to 24 in.

GOLDEN-ANDERSON

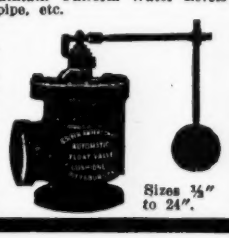
Pat. Automatic Double Cushioned Check Valves

1. Especially adapted for Water Service.
2. For High or Low Pressure.
3. Thoroughly Cushioned. No Chattering, Hammering or Sticking.
4. Globe or Angle Patterns up to 24 in.
5. Especially adapted for hydraulic elevator service.

GOLDEN-ANDERSON

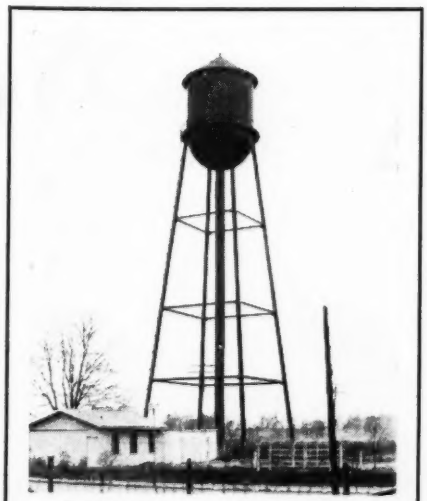
Pat. Automatic Cushioned Water Float Valves

1. Automatically Maintain Uniform Water Levels in Tanks, Standpipe, etc.
2. Instantly Adjusted to Operate Quickly or Slowly.
3. Floats Swivel to any Angle—Most Satisfactory Float Valves known.
4. No Metal-to-Metal Seats—No Water Hammer or Shock.
5. Cushioned by Air and Water.



Sizes ½" to 24".

TANKS



Bardstown, Ky.—150,000 gallons

. . . for . . .

Municipal Water Works Systems

Wherever water is needed, Pittsburgh-Des Moines elevated tanks, standpipes and steel reservoirs furnish economical, dependable storage. Large cities are giving better water service by installing several tanks for auxiliary storage in their outlying districts. Small communities are improving their systems and insuring steady pressure by installing a single central tank.

Our nearest office will gladly submit designs and estimates of storage tanks for your requirements.

Pittsburgh-Des Moines Steel Company

4 Neville Island, Pittsburgh, Pa.

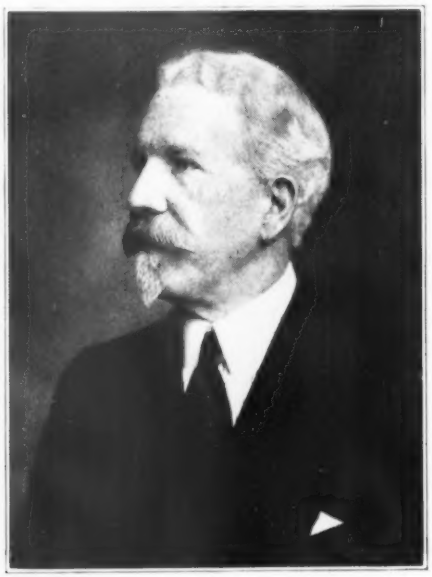
Des Moines — New York — Chicago
Atlanta — Dallas — Seattle — San Francisco

Ludlow Valve Elects New President and Board Chairman

James H. Caldwell has been elected Chairman of the Board of The Ludlow Valve Mfg. Co., Troy, N. Y., with which he has been associated as a general manager for 41 years, during 27 of which he was also President of the Company.

Always active in the interests of the Waterworks Manufacturers' Association, Mr. Caldwell has served as its President and has been chairman of the Flange Standardization Committee of the Valve Manufacturers' Association.

Born at Mobile, Ala., Mr. Caldwell is a graduate of Rensselaer Polytechnic Institute, Troy, N. Y., and a member of its Board of Trustees. He is also a Director of the Manufacturers' National Bank of Troy, N. Y., and active in philanthropic work, particularly in behalf of the Samaritan Hospital and the Y. M. C. A. of Troy.



Mr. James H. Caldwell

The presidency of The Ludlow Valve Mfg. Co., has been filled by the election of William H. Lolley, who is also Director and General Manager. For a number of years associated with Ludlow interests as Sales and Engineering Consultant, Mr. Lolley brings to his new office wide experience in industrial production, particularly with respect to close precision tools in the automotive and other branches of the metal working industries.

Born in Perth, Scotland, a graduate of Springfield College and Polytechnic Institute of London, Mr. Lolley has represented substantial American manufacturers in England, France and Germany, introducing American products, machinery and methods.

The Ludlow Valve Mfg. Co., was organized and started business in January, 1866, at Troy, N. Y. By 1896

Mr. William H. Lolley

the business had successively outgrown three plants. At that time they purchased the property of the Troy Steel & Iron Co., and at the same time started construction of a new factory along the Hudson River adjoining the N. Y. Central freight yards, thus providing for excellent shipping facilities.

Operations were started at the new plant early in 1897.

Business continuing to expand, an adjacent plot of ground and buildings were acquired and a new foundry measuring 138x367 feet constructed in 1903. At the same time the machine shop was remodelled and enlarged to 210x378 feet.

The Company has recently acquired additional ground and contemplates an increase of production facilities at an early date as part of a program of expansion, diversification of products and general development.

"Everything for the Pool"

Mr. John R. Mudge, manager of the Chemical Equipment Corporation of California, states that his organization can with their own equipment or with equipment for which they are exclusive agents furnish everything needed for the pool.

This company is one of the progressive corporations serving the great state of California. Offices, warehouse and shop facilities are located at 110 N. Alameda St., Los Angeles, where they have plenty of room for future expansion. New machines are carried in stock in order to make immediate delivery and the shop is equipped for making all necessary repairs.

When this company increased their working facilities last fall it was said to be partly because of the rapidly increasing business in the sale and servicing of the Paradon Chlorinators which they represent in California, in addition to the well-known "Chemco Service" and "Everything for the Pool." N. Y. Continental Jewell filters, made in Los Angeles, the Everson vacuum plunge sweeper and the Everson plunge fittings, pumps, hair and lint catchers and other related equipment are some of the reasons for the activities of Chemical Equipment Corporation.

Copper and Brass Pipe Show High Sales

Sales of brass and copper pipe and tubing reached a new high total of 77,992,084 pounds during 1929, according to an estimate just completed by the Copper and Brass Research Association.

Sales in 1929 were practically five times the 16,016,500 pounds sold in 1922, notwithstanding reduced building activity during the year. Sales in 1928 amounted to 76,777,400 pounds.

Statistics compiled by the Association show that since 1922 sales of brass and copper pipe and tubing have increased 387 per cent. The average annual increase for the last six years is 63.67 per cent.

The Chain Belt Company of Milwaukee, Wisconsin announces the appointment of the Corbin Supply Company of Macon, Georgia as representatives for their complete line of chain and transmission equipment.

Rex equipment, made by the Chain Belt Company, includes a broad line of chain and power transmission equipment conveyors and conveying systems for an important series of industries, concrete mixers, pavers, pumps, saw rigs, plaster and mortar mixers as well as a number of allied products.

Sullivan Machinery Company of Chicago announces that Mr. Morley S. Sloman, who has been associated with their Pittsburgh office for the past fourteen years, has been appointed manager at Huntington. Mr. Sloman will succeed Mr. John S. Walker, Jr., who has been manager of the Huntington branch since its establishment in 1912 and who has retired to engage in the banking business.

Van Dyke Transferred To New York

B. Van Dyke, of the Quincy, Ill., sales division of the Gardner-Denver Co., has been transferred to the New York office of the organization. Hendrick Stolk, until recently with Stoksvis & Zonen, of Holland, has just been transferred to St. Louis from the Quincy plant where he completed a sales study course.

Electric Machinery Manufacturing Company announces that after the first of April, their Chicago office will have a new location. The new office will be in Room 1567, 20 North Wacker Drive Building, (Civic Opera Building).

POMONA
Oceans of Water
PUMPS

Cleanest WATER FOR EVERY NEED . . .

There are in the United States over a score of towns and cities that depend solely on Pomona Water Lubricated Turbine Pumps for production of their entire water supply. There is a real reason why city engineers prefer the Pomona. In the first place its performance is most dependable and the water produced is cleanest. The Pump is correctly designed mechanically and hydraulically. Its operation is smooth and vibrationless. Its manufacture is gauged by standardized production methods which assure interchangeable parts. All pumps are serially numbered and every part is correctly recorded assuring correct replacement of parts in the shortest possible time.

Write for name of Distributor or Factory Representative located in all principal cities.

POMONA PUMP CO.
Pomona, California

POMONA PUMPS

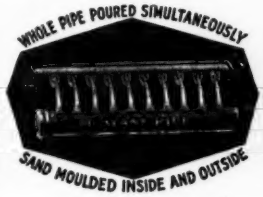
McWane Pipe "Eats" Curves!

By which we mean that the Precalked Joints round curves in your mains perfectly.—An important factor in these days of curving streets in residential developments.

No lead-pot, no yarning, no pouring, you just "socket and 'sock' it" with a calking hammer to lay McWane Precalked Joint Cast Iron Pipe. "3 times the speed for half the labor."

SAND CAST McWANE

Pipe is SAND CAST —yet modern in weights and strengths.



SIZE RANGE

1¼ thru 12 inches. Standard lengths. Precalked Joints or open bells.

McWANE 1¼ and 2 inch cast iron pipe with Precalked Joints gives you a permanent pipe in the small diameters, too. Avoid rust with it, at low cost.

WRITE FOR ILLUSTRATED LITERATURE

McWANE CAST IRON PIPE

McWANE CAST IRON PIPE COMPANY
BIRMINGHAM, ALA.

PACIFIC STATES CAST IRON PIPE COMPANY
PROVO, UTAH.

PRINCIPAL CITIES

SERVICE EXCHANGE
For
Manufacturers or Distributors

Editor's Note.—From time to time we receive letters from distributors wishing to be put in touch with manufacturers of certain lines of equipment, or from manufacturers seeking representatives for their products. Items of this kind will be published and names and addresses furnished interested persons upon request.

New Lines Wanted

Water Works equipment distributor, covering northeastern Indiana, would like to secure represenation of a line of chlorinators.

Manufacturer's representative, covering Massachusetts, Rhode Island and southern New Hampshire, would like to secure line of speed reducers and gears.

Manufacturer's representative now handling centrifugal pumps would like to secure other lines in water works field. Covers eastern Pennsylvania, south Jersey and Delaware.

Established distributor having large warehouse facilities, serving Florida and adjacent territory would like to add to lines now represented, such as road building material and equipment, industrial equipment and contractors' equipment and materials and diesel engines.

Distributor covering northern California, having warehouse facilities, would like to secure line of water meters, pipe jacks or pushers, flow meters, and sewage treatment and disposal material and equipment.

Manufacturer's representative, with warehouse facilities available, would like to secure additional lines in water works and sewerage and general contracting fields. Covers Houston and San Antonio territory.

Manufacturer's representative with 25 years sales experience, conversant with all types of pumps and their field, desires agency for either New York or export territory, or both.

Manufacturers' agents representing well known lines of water works equipment desire to secure line of pipe pushers and other similar equipment for California and western Nevada territory.

Equipment distributor located in Michigan desires to add two or three good lines to serve territory in southeastern part of state.

Machinery distributor established in Porto Rico and Santo Domingo would be pleased to make arrangements to take on new lines in these territories.

A Michigan distributor, with many year's experience, representing at this time prominent manufacturers of pumping machinery, offers the services of an established representative to manufacturers needing incrased facilities in this region.

Canadian distributor of equipment for water softening, filtration, sewage purification and pumping is interested in securing exclusive sales rights for kindred equipment in the Dominion.

Representatives Wanted

Manufacturer of non-clogging sewage pumps, both horizontal and vertical, as well as water works pumps suitable for municipalities of 50,000 or 60,000 people, is interested in securing additional sales representation.

Distributors wanted for deep-well turbine pumping unit. Product serves small industrial plants, private estates and farmers.

Manufacturer of water works brass goods would like to make proposition to manufacturers' representatives calling on water works' trade.

District representatives wanted for sanitary engineering specialty used extensively in the water works, sewage and swimming pool fields.

Manufacturer of paving expansion joints is seeking distributors and manufacturers' agents in good, unassigned territory.

Manufacturer of air compressors and contractors' tools has number of desirable territories open. Full co-operation will be extended to distributors.

Manufacturer of contractors and builders levels and transits is seeking district sales manager. Exclusive contract given. Excellent territory still available. Backed by national advertising.

Well established manufacturers' representatives wanted to handle sand and gravel pumps and equipment, in key cities, by successful manufacturer of high grade dredging pumps and hydraulic dredging equipment. Give character of equipment now being handled and territory covered.

Manufacturer of hoisting machinery and air compressors has open territory in New York and New England states for aggressive distributor.

Attractive territory available for experienced men to handle contractors labor-saving equipment by old established company. Equipment backed by national advertising.

A manufacturer of paving expansion joints is looking for distributors for northern California territory.

Manufacturer of metal lath, corner beads, channels and reinforcing mesh desires to secure distributors for products in the southwest and middlewest.

Manufacturer of threadless pipe couplings and tees, with rapidly growing business, is seeking additional representatives.

Manufacturer of mechanical spreaders for cover material desires representation by organizations covering entire states. Several desirable states are still open. Number of inquiries now on hand for spreaders require immediate follow up.

Manufacturer of complete line of construction equipment, mixers, saw rigs, plaster and mortar mixers and pumps has an open territory in the state of Maine and is looking for an aggressive distributor to represent him there.

Long established and well-known manufacturer of industrial locomotives wishes to make contacts with qualified distributors. Locomotive line includes steam, gasoline, gas-electric and oil-electric. Supported by national trade journal advertising.

Manufacturer of cut to length, easily erected standardized steel highway bridges, for spans up to and including 40 feet, which are sold to highway commissioners and superintendents, has attractive territory open in states south and west of Chicago.

Manufacturer of Transverse Testing Machines desires to build up distribution organization in this country and abroad.

Manufacturer of plows, grade-rippers and scrapers desires representation in Arizona, New Mexico, Arkansas, Kansas and Louisiana.

One of the leading manufacturers of surveying instruments in the United States is seeking responsible agents in all sections of the country. Instruments are nationally advertised in all leading engineering journals.

Manufacturer of patented reflecting signs and devices desires representative for New York City, Long Island, Westchester County and adjacent territory. Some one selling other products to municipalities preferred.